DRAFT
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California Dispersant Plan and Federal On-Scene Coordinator (FOSC) Checklist

for

California Federal Offshore Waters

Prepared for RRT IX by the
Los Angeles-North and Los Angeles-South Area Committees

January 2004

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OVERVIEW

Purpose and authority

This document outlines the Dispersant Use Plan for state and federal marine waters within the Region IX Regional Response Team (RRT) area of operations.

This policy authorizes and provides guidelines to allow the federally pre-designated U. S. Coast Guard (USCG) Federal On-Scene Coordinator (FOSC) and/or the Unified Command to use dispersants in a timely manner to: 1) prevent or substantially reduce a hazard to human life; 2) minimize the adverse environmental impact of the spilled oil; and 3) reduce or eliminate the economic or aesthetic losses of recreational areas. This dispersant use plan will address the use of dispersants for each of two zones: Dispersant Pre-Approval Zones; and, RRT Approval Required Zones.

Subpart J of the National Contingency Plan (NCP) provides that the FOSC, with the concurrence of the EPA representative to the Regional Response Team and the State with jurisdiction over the navigable waters threatened by the oil discharge, and in consultation with the U.S. Department of Commerce (DOC) and U.S. Department of the Interior (DOI) natural resource trustees, when practicable, may authorize the use of dispersants on oil discharges; provided, however, that such dispersants are listed on the NCP Product Schedule. The EPA has been delegated authority to maintain a schedule of chemical countermeasures that may be authorized for oil discharges in accordance with procedures set forth in Section 300.900 of the NCP.

The USCG Eleventh District Commander has pre-designated the three USCG Captains of The Port (COTP) as the FOSCs for oil discharges in their respective COTP zones (as defined in 33 CFR Part 3 and subject to joint response boundary agreements with EPA described in Section 1400 of the three California Area Contingency Plans), and has delegated to each COTP the authority and responsibility for compliance with the Federal Water Pollution Control Act (FWPCA).

The Governor of the State of California has designated the Administrator of the Department of Fish and Game Office of Oil Spill Prevention and Response (CDFG-OSPR) the authority and responsibility for providing approval for the use of dispersants for control of oil spills in or affecting California waters.

The USCG, EPA, DOI, DOC/NOAA, and CDFG-OSPR agree that one of the primary methods of controlling discharged oil shall be the physical removal of the oil by mechanical means. These agencies recognize that in certain instances timely, effective physical containment, collection and removal of the oil may not be possible, and the use of dispersants, alone or in conjunction with other removal methods, may be considered to minimize substantial threat to public health or welfare, or minimize serious environmental damage. This document establishes the policy under which dispersants listed on the NCP Product Schedule may be used in Federal waters off California by FOSCs.

The response planning process

The National Oil and Hazardous Substances Pollution Contingency Plan (National Contingency Plan - NCP) directs the RRTs and Area Committees to address, as part of their planning activities, the desirability of using appropriate dispersants, surface washing agents, surface collecting agents, bioremediation agents, or miscellaneous oil spill control agents listed on the NCP Product Schedule, and the desirability of using appropriate burning agents. Regional Contingency Plans and Area Contingency Plans shall, as appropriate, include applicable authorization plans and address the specific contexts in which such products should and should not be used (40 CFR § 300.910).

The use of dispersants in marine waters off California requires detailed foresight and planning. In an effort to expedite a decision to use dispersants and reduce first strike response time, the Regional Response Team Region IX in August of 2000 adopted formal changes to the planning and operations sections of the Regional Contingency Plan (RCP) (Appendix K). These sections detail a dispersant use planning process to be undertaken by each of the six California marine Area Committees (AC). Specifically, each AC was tasked with designation of approval zones for dispersant use within its area of operation and the development of a dispersant use plan to include at least the following: 1) Incident Command System (ICS) protocols and forms, 2) Federal On-Scene Coordinator Checklist, 3) dispersant monitoring plan, and 4) wildlife spotting protocols. Finally, each committee was asked to review training and drill requirements for plan implementation as well as dispersant response equipment assuming a 4-hour response time.

Beginning in February 2001, each Area Committee (North Coast, San Francisco-Bay Delta, Central Coast, Los Angeles-North, Los Angeles-South, San Diego) designated a dispersant subcommittee to develop their regional dispersant use zone recommendations. Los Angeles subsequently combined LA-north and LA-south efforts under one subcommittee. San Diego developed an additional Sea Bird Task Force that compiled sea bird information primarily for the Southern California Bight area, and reported their results to the San Diego dispersant subcommittee for their particular consideration in developing recommended zones. All subcommittees initiated the planning process by gathering the pertinent resource data for the region and becoming familiar with the effects of dispersants and dispersed oil in the marine environment. Based on the information reviewed, each subcommittee developed a Net Environmental Benefit Analysis (NEBA) to aid them in constructing the area's dispersant use zone recommendations. Based on the results of the NEBA, each subcommittee ultimately concluded that in the case of dispersible crude and fuel oils, dispersing the spilled oil into the water column may, on balance, be less harmful to the environment than letting the oil remain on the ocean's surface for extended periods of time.

Each subcommittee and Area Committee drafted their dispersant zone recommendations, along with some general dispersant application guidelines, and forwarded those through the U.S. Coast Guard to the RRT. All zone recommendations were approved by the RRT between February 2002 and July 2003. Parallel to the RRT dispersant zone review and approval process, the Los Angeles subcommittee was continuing to meet in workgroups to develop drafts of the other elements (updated FOSC checklist, Wildlife Observation Protocols, Public Outreach Plan, dispersant shortfall analysis, and incorporation of dispersant effectiveness monitoring) necessary to make a complete Area Dispersant Plan (ADP). In doing so, there was a recognition that much of the Los Angeles effort would not only be useful as a starting point for similar efforts by other Area Committees in developing their individual ADPs, but would in fact mature into an overarching California Dispersant Plan that would serve all six marine Area Committee regions in the state and save them the need to develop five other, largely redundant, dispersant plans. This California Dispersant Plan (CDP) includes the zones for each area, as well as an updated Federal On-Scene Coordinator (FOSC) checklist and all appendices needed to implement the CDP.

The Net Environmental Benefit Analysis (NEBA) Process

Once oil is spilled to the ocean there will be inevitable impacts to the environment within the geographical area of the spill no matter how much effort is put into spill response. The primary goal of any oil spill response is to minimize the area of impact and remove the spilled oil from the water's surface as fast as possible, thus minimizing the impact to the organisms inhabiting the terrestrial, estuarine, intertidal, shallow subtidal and ocean surface environments. This response goal is not meant to overlook the potential for impacts to the organisms found immediately below the ocean surface, but instead provides a mechanism for discussion of the environmental trade-offs associated with any response option.

Each regional dispersant subcommittee assessed and compared the impacts of an oil spill and associated cleanup activities on the biological resources of their area. This examination was conducted using a Net Environmental Benefit Analysis (NEBA), modeled on an Ecological Risk Assessment previously conducted for the San Francisco Bay. In each case, the NEBA examined and compared the risk to the environment associated with available oil spill response options. Spill response options evaluated were 1) no on-water response, 2) mechanical cleanup, 3) *in situ* burning, and 4) dispersant use. The risks of these cleanup options were examined using a NEBA risk matrix, which qualitatively combined the risk to the biological resource resulting from both the magnitude (percentage) of the population impacted with the expected time for the population to recover from the impact.

The NEBA in each area was conducted using an assumed spill of Alaska North Slope crude oil, a dispersible crude oil commonly transported along the coast of California. The approach was a "what-if" analysis in that all sensitive species that could be found in a region, regardless of time of year, were incorporated. This approach was undertaken to eliminate the need to conduct the multiple NEBAs necessary to address spatial and temporal differences found each region. By using this approach, each dispersant subcommittee had all the pertinent resource information at their disposal at one time and could examine and incorporate temporal and spatial differences in their single analysis.

Each regional NEBA had the same general findings:

1) In average or worse-than-average offshore response settings, and/or where spill distance from shore significantly increases the response time, mechanical cleanup techniques and *in situ* burning may, by themselves, provide very little improvement over the no response option. When this is the case, these response techniques will not significantly reduce the risk of spilled oil contacting biological resources at the sea surface or in more inshore (*e.g.*, intertidal) regions.

2) When used in an appropriate and timely manner, dispersants can remove a significant amount of oil from the surface water. Appropriate and timely application includes a number of decision factors, included in this CDP.

3) While dispersants may measurably reduce the risk of oil to surface and coastal biological resources, there may be a temporally limited increase in risk to the plankton community in the upper several meters of the water column.

4) Shoreline cleanup methods may not be available or appropriate for use in some sensitive coastal habitats (*e.g.*, rocky intertidal, marshes, wetlands); their inappropriate use may pose a greater risk to these sensitive habitats and dependent species than the oil itself. The goal in this case shifts to keeping the oil from ever reaching sensitive coastal and inland areas.

In the NEBA process, the benefits and risks of each cleanup option were evaluated separately. However, an effective spill response may use a combination of several available response options. Oceanographic conditions permitting, it is expected that dispersants would be used in combination with mechanical cleanup equipment and response strategies.

NEBA results suggested that the appropriate and timely use of dispersants (on oil spills characterized as "dispersible") could greatly enhance the ability to remove significant quantities of oil from the offshore water surface. This may greatly reduce the risk of spilled oil reaching the more abundant and sensitive habitats and species found in the more inshore, coastal areas. While dispersing oil into the water column can pose a short-term risk to the plankton community inhabiting the upper few meters of the water column, the impacts will be to a much more geographically limited area, and the temporal duration will be relatively very short. The environmental "trade-off" decision-making at the time of a response – weighing the impacts associated with oil on the surface for weeks to months versus the short term toxicity (minutes to hours) resulting from dispersed oil in the water column – can and will be made by the response agencies on a case-by-case spill response basis.

The detailed NEBA matrices developed by each regional dispersant subcommittee are not part of this report, although information about particular resources of concern is summarized in Appendix B.

Environmental "Trade-off" Decisions

The proposed area dispersant zone recommendations acknowledge that weighing of environmental "trade-offs" is not as easy as it may seem, even when information on sensitive resources has been gathered ahead of time. Information on species occurrences and distributions is still very incomplete, as is our knowledge of how they may be affected by prevailing oceanographic conditions.

No resource can be categorized as always being of greater or lesser value than another. For instance, while spill impacts on seabirds, mammals and sensitive communities are more "apparent" to scientists, responders and the general public, other more "hidden" resources (such as the seasonal plankton community in the upper water column) are at potentially greater risk from oil dispersed into the water. This community may contain the larvae of important sport, commercial, and/or ecologically significant (*i.e.*, primary or important animal prey) species.

The following were understandings regarding the plankton communities at risk from a dispersed oil plume:

- In most imaginable response settings, it may be better to disperse the oil into the water column (where there may be short-term toxicity to larvae in the upper few meters of the water column) than to leave the undispersed and unrecoverable oil on the water surface (where it could reside long-term, spread, and potentially impact a wider range of sensitive coastal species and habitats).

- Due to the spatial and temporal distribution of larval species, the dispersed oil from any one oil spill response was expected to impact a very limited portion of the overall community. Many constituent plankton species would quickly replenish their numbers through reproduction or immigration from surrounding waters. It was therefore considered unlikely that there would be population-level affects to the plankton community.

- The concentration of dispersed oil in the open ocean can decrease rapidly through natural dispersion and biodegradation processes. The dispersed oil plume can spread and thin quickly in the three-dimensional space of the water column, and natural biodegradation processes work quickly to break the small droplets of oil in the plume into carbon dioxide and water. In areas where the dilution potential is the greatest (*i.e.*, open ocean), concentrations of dispersed oil high enough to cause adverse effects are unlikely to persist for more than several hours. Oil concentrations are typically less than 50 part per million (ppm) below dispersed slicks, although different authors report slightly different upper levels. Field data indicate that concentrations of dispersed oil are usually less than 1 ppm at depths below 10 meters. Within a matter of weeks to months, dispersion and biodegradation processes can remove much of the plume of oil droplets from the upper water column, and/or reduce concentrations of oil in the water column and at depth to scientifically non-detectable levels.

- In contrast, undispersed and unrecovered oil left on the water's surface in the open ocean can drift for weeks to months, where it can continue to impact pelagic birds, mammals and perhaps sea turtles. If the oil moves toward shore, it can strand in sensitive coastal habitats (especially intertidal areas) and pose a persistent threat, on a time scale of months to years, to those sensitive coastal habitats and their dependent species and communities.

- Emulsification of the oil remaining at the water surface increases the oil-in-water volume, and hence the contamination risk to marine and coastal plant and animal communities.

Oil spill impacts to marine birds and mammals can threaten the existence and persistence of whole colonies and perhaps the entire population of some species. This is especially true for colonies and populations of common murres, the endangered marbled murrelet, shorebirds (including the endangered western snowy plover) and the southern sea otter.

Stakeholder involvement and outreach efforts

The regional Area Committees, which developed the pre-approval dispersant zone recommendations, and from those this document, are mandated by the Oil Pollution Act of 1990 to include any interested member of the public. Given the sensitivity that dispersant use issues can raise, each regional Area Committee made special and repeated efforts to bring interested stakeholders onto the dispersant subcommittees even if they had not shown previous or consistent interest in other Area Committee response planning work. Generally, in spite of these efforts, most dispersant subcommittees came to include those who were already the most active in their respective Area Committees. Statewide information-sharing and continuity was provided by Mike Sowby (Office of Spill Prevention and Response (OSPR)), Yvonne Addassi (OSPR), Ellen Faurot-Daniels (California Coastal Commission (CCC)) and Heather Parker-Hall (National Oceanic and Atmospheric Administration (NOAA)).

In early 2001, a team of RRT representatives (Bill Robberson, Environmental Protection Agency (EPA); Heather Parker-Hall, NOAA; Mike Sowby, OSPR) made a presentation at a public meeting of the California Coastal Commission; another presentation of the same material was later made at the Gulf of the Farallons Research Symposium. Throughout 2001 and 2002, Yvonne Addassi and Heather Parker-Hall launched several "Stakeholder Meetings" to distribute the dispersant response planning information to other agencies and interested members of the public. The OSPR and NOAA staff also provided the materials for the U.S. Fish and Wildlife Service and National Marine Fisheries Service reviews, and regularly briefed the RRT on progress of each dispersant subcommittee. OSPR and CCC staff regularly briefed the state Oil Spill Technical Advisory Committee.

Further public outreach, once this plan is tested and before it is finalized, will be offered in public information sessions at several coastal locations in California and at a public meeting of the California Coastal Commission. The U.S. Coast Guard will also publish a Federal Register Notice of this plan once it is finalized, on which the public may comment.

What is in the California Dispersant Plan (CDP)

In its current form, the CDP includes an updated Federal On-Scene Coordinator (FOSC) checklist, and a series of discussion and decision boxes to facilitate the FOSC decision. To provide the greatest likelihood that this CDP will not only train but serve the Coast Guard regardless of which personnel are in the FOSC position in the future, it includes a number of appended materials that put oil, dispersant, natural resource and response resource information close at hand in one document. The CDP also includes a number of blank forms that can be removed, duplicated as needed, and used in the field during a spill response to provide orderly and timely information to the FOSC as the spill unfolds and a decision whether or not to use dispersants becomes imminent. Other report forms document bird and mammal presence, dispersant application methods, and dispersant effectiveness.

This document is not a lengthy discussion of the relative merits of any response tool, of dispersant or dispersed oil toxicity, or the details of Net Environmental Benefit Analyses (although key points on several of these topics is embedded in the Discussion Notes on the FOSC checklist, or in the appendices). It is not a primer on oil spill response in general, or the Incident Command System. All this information is available from other resources, much of which was considered in developing the zone recommendations and CDP. This CDP instead assumes that an oil spill has occurred and all agency notifications have been made, various response agencies are on scene and using the Incident Command System to structure the response, and that dispersant use is under active consideration by the FOSC. This CDP takes over from there, offering tools to the FOSC to guide that decision.

This CDP primarily focuses on the federal offshore waters that have been designated as "pre-approved" for dispersant use. To date, this includes the waters 3 – 200 nautical miles from shore and not within a National Marine Sanctuary. This CDP also addresses waters closer than 3 miles from shore or within a National Marine Sanctuary, which fall, until further notice, under the RRT Approval Process.

This CDP has several potential uses: 1) In it's current form it can serve as a single, statewide, stand-alone collateral response plan to <u>all</u> of California's three Area Contingency Plans, and/or 2) each of the three Captain of the Port (COTP) areas can remove the few pages of Appendix B that do not pertain to their area, and transform this CDP into their regional Area Dispersant Plan, and 3) the CDP, in whole or in part, could go in each Area Contingency Plan and/or the Regional Contingency Plan. Regardless of the multiple purposes for which this CDP may be used, it's primary value is that it is a central, portable repository of all information that will guide the FOSC in a dispersant-use decision for pre-approval areas in federal offshore waters, regardless of which COTP pre-approval area the spill occurs and for which dispersants are being considered.

Acknowledgements

The principal organizer and compiler of this report was Ellen Faurot-Daniels (CCC), with critical conceptual input and resource information support provided by Yvonne Addassi (OSPR). Creating this draft California Dispersant Plan would not have proceeded smoothly or successfully without the contributions of thought, effort and review provided by many others.

We relied extensively on work already completed by other authors and institutions. Leigh Stevens of Cawthron Institute, New Zealand, led the way by allowing us to use his “Oil Spill Dispersants: Guidelines for Use in New Zealand” as an extremely helpful model for our document. We also drew from various dispersant guidelines provided by Regional Response Teams throughout the U.S., dispersant guidelines published by ExxonMobil, the Cutter Information Corporation’s “Oil Spill Dispersants: From Technology to Policy”, the “Assessment of the Use of Dispersants on Oil Spills in California Marine Waters” by S.L. Ross, and various oil spill job aids available from the NOAA web site. Please see the References Cited section in this document for the full citations.

Beyond the use of these reports was the steadfast assistance of those we worked with in our own agencies and those on the Los Angeles Area Committee, dispersant subcommittee, dispersant workgroups, and various interested parties watching and assisting from outside the immediate working groups. Randy Imai of OSPR provided the charts in this report, Al Allen (Spilltec) provided the information, figures and formulas for dispersant dosage rates and relating those rates to dispersant application systems, and the three oil spill clean-up cooperatives in California (Steve Ricks for Clean Bay, Jim Caesar for Clean Seas, Ray Nottingham for Clean Coastal Waters) provided updated information on dispersant application resources. Members of the Los Angeles workgroups reviewed early drafts of this document, with John Day (Santa Barbara County) and Craig Ogawa (Minerals Management Service) providing especially helpful comments along the way. Ben Waltenberger (NOAA), Ken Wilson (OSPR), Melissa Boggs-Blalack (OSPR) and Ellen Faurot-Daniels (CCC) pitched in to draft the Wildlife Aerial Observation Protocols, and Melissa Boggs-Blalack led the workgroup addressing public outreach.

We also extend particularly heartfelt thanks our colleagues in our own agencies (Alison Dettmer and Al Wanger of the CCC; Mike Sowby, Ken Mayer and Carlton Moore of OSPR) who supported our efforts all along the way, and to the members of the Regional IX Regional Response Team and the U.S. Coast Guard who had the first vision of a California Dispersant Plan.

DISPERSANT PRE-APPROVAL ASSESSMENT FORM

(Two pages)

Information gathered to complete this form would greatly facilitate the dispersant pre-approval use determination.

This report made by: ______________________ Organization: __________________ Date: _________ Time: _________
Phone: (   )____________Fax: (   )____________ Mobile: (   )__________________ Pager: (   )________________

On-Scene Commander: ______________________ Agency: ______________________________________
Phone: (   )____________ Fax: (   )____________ Mobile: (   )__________________ Pager: (   )________________

Caller: __________________________________ Organization: __________________ Date: _________ Time: _________
Phone: (   )____________ Fax: (   )____________ Mobile: (   )__________________ Pager: (   )________________
Street: __________________________________ City ______________________ State ______ Zip Code _________

SPILL

Date of spill: ________________(month/day/year) Time of spill: ____________________________(PST, 24-hr clock)
Location: Latitude: ______________________N Longitude: ____W

Spill source and cause: ____
____

Amount spilled: ______________(gal or bbl) Type of release: ❒ Instantaneous ❒ Continuous
Flow rate if continuous flow (estimate): __________
Oil name: ______________________________ API: ________ Pour point: _________ (ºC or ºF)
Circle one

Information source: ____

ON-SCENE WEATHER, CURRENTS AND TIDES

(If not immediately available contact NOAA Scientific Support Coordinator (206-321-3320) or other resources noted in Appendix A).

Wind (from) direction: __________________ Next low tide: ______ (ft) at _______ (hrs)
Wind speed: ______________ (miles/hr or knots) Next high tide: ______ (ft) at _______ (hrs)

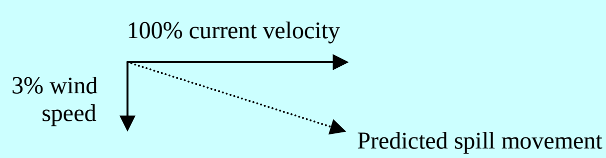
Current velocity: _________ (kts) Current (to) direction: _________ (ºtrue/magnetic)
Predicted slick speed: _________ (kts) Predicted slick direction: _________ (ºtrue magnetic)

Visibility: ______________ (nautical miles) Ceiling: ________ (feet) Sea state:_______ (wave height in feet)

Information source:____

PREDICTING SPILL MOVEMENT

Plot spill movement on appropriate nautical chart. Using the information from the box above, predict slick direction and speed using 100% of current velocity and 3% of wind speed.



Estimated distance to shore/sensitive area: _________ (mi/km)
Estimated time to shore/sensitive area: _________ (hrs)

ESTIMATING OIL SPILL VOLUME

Extent of spill:

(a) Length of spill ______(km) x Width of spill ______(km) = Total spill area _________(km^2)

(b) Estimate what proportion (%) of the total spill area is covered by oil: _______ (Express as decimal, % x 100)

(c) Estimate slick area: _______________ x _______________ = _________________

Total slick area (a) % oil cover (b) Estimated slick area

Estimated spill volume:

You can make this estimate using any of the following approaches:

- Get a thickness estimate from the ADIOS oil weathering model (call the NOAA SSC (201-321-3320) for assistance);
- Generate your own volume estimate of spilled oil and the area it covers (convert both volume and area to metric units and then divide the volume by the area to estimate the thickness. Use the unit conversions found in Appendix M). Convert thickness to millimeters to use Appendix D.1).
- Use your knowledge of the approximate number of barrels of oil or emulsion per acre of slick.

POTENTIAL RESOURCE IMPACTS

Using the predictive spill and weather information from the boxes above, ADIOS, the NOAA SSC, other RRT trustee agencies, aerial wildlife observers and regional resource information noted in Appendix B, briefly describe potential coastal areas and resources that could be impacted from this spill.

DISPERSANT SPRAY OPERATION

Information from Appendices C.5 – C.8 and D.1 will be helpful.

Dispersant spray contractor name: ______________________________

Dispersant name: ____________________ Quantity available: ________

Street: ______________________

City: ______________________

State: _______ Zip Code: ___________

Phone: ( )____________________

Platform: Aircraft type: ❒ Multi-engine ❒ Single-engine

Boat type: ___________________________

Other: ___________________________

Dispersant load capability (gal): _______________

FOSC Complete:

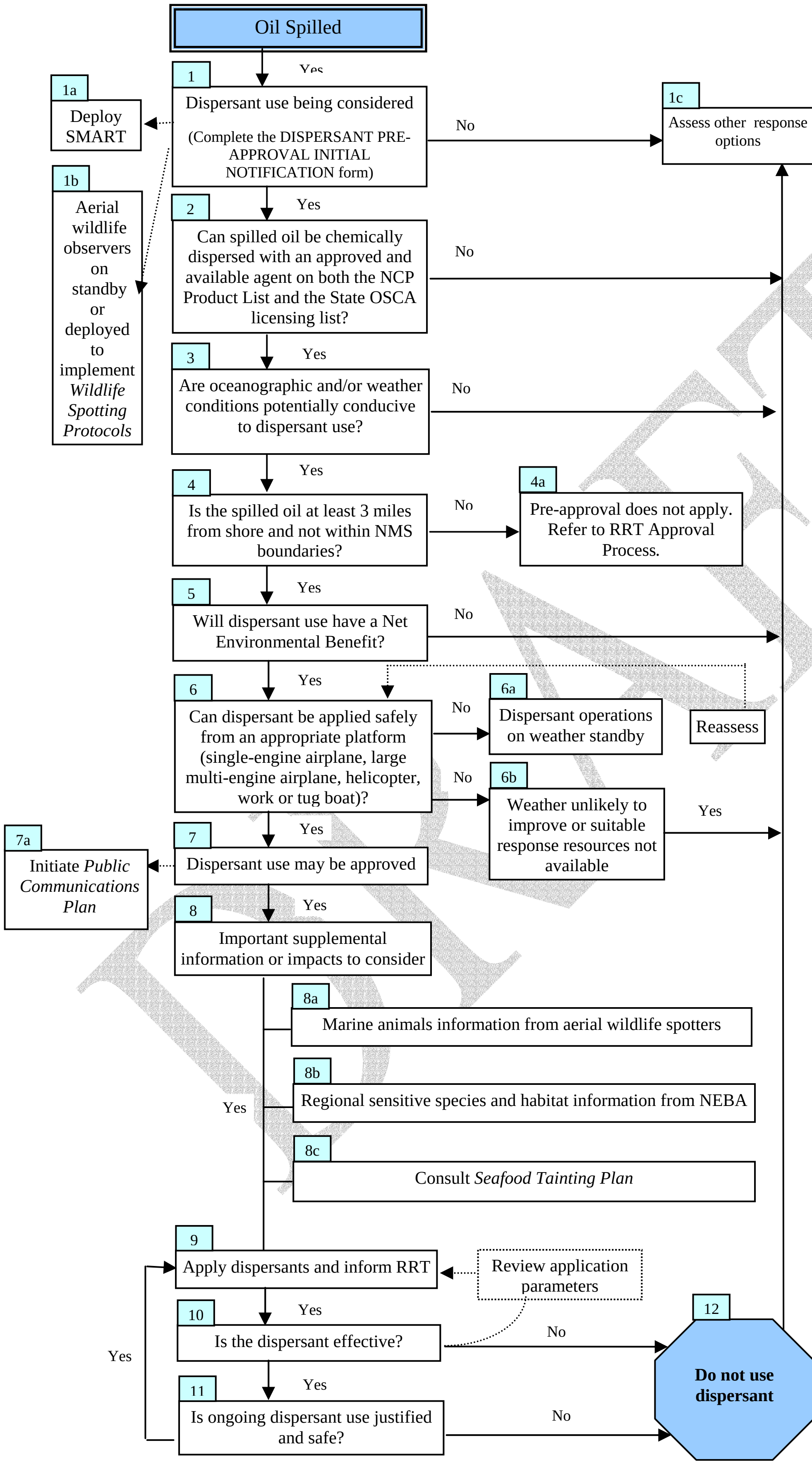
"Window of opportunity" for getting dispersant on the oil: ____________________ (hrs from first report of spill)

Number of daylight hours available for first day of dispersant application:____________ (hrs from first report of spill)

Time to first drop on the oil: ______________________________ (hrs from first report of spill)

Can dispersants to be effective after day one of the spill? YES / NO / MAYBE (circle one)

DISPERSANT USE FLOWCHART



Dispersant Decision Summary

Spill location: ____________________

Decisions approved by: ________________

Box	Decision	Time:	Date:	Initials:
1	Yes/No	____	_______	_______
2	Yes/No	____	_______	_______
3	Yes/No	____	_______	_______
4	Yes/No	____	_______	_______
5	Yes/No	____	_______	_______
6	Yes/No	____	_______	_______
7	Yes/No	____	_______	_______
8	Yes/No	____	_______	_______
9	Yes/No	____	_______	_______
10	Yes/No	____	_______	_______
11	Yes/No	____	_______	_______
12	Do Not Use	____	_______	_______

Comments:

....

BOX 1 **IS DISPERSANT USE BEING CONSIDERED?**

Dispersant use should be considered if one or more of the situations listed below exist:

- ❒ Oil is likely to significantly impact birds, marine mammals, or other flora and fauna at the water surface
- ❒ Natural dispersion is limited
- ❒ Other response techniques are unlikely to be adequate, effective, or economical
- ❒ The oil could emulsify and form mousse or tar balls
- ❒ Oil is likely to significantly impact shorelines, structures and facilities (*e.g*., marinas, wharves)
- ❒ Oil is likely to significantly impact economically important resources (*e.g*., shellfish beds, tourist beaches)
- ❒ Other ………

Decision: Consider dispersant use?

			Date	Time
❒	Yes	Make notifications in **Box 1a**	……….	……….
		Make notifications in **Box 1b**	……….	....
❒	No	Go to **Box 1c**	……….	……….

From Cawthron, 2000

Discussion Note 1.1 **KEY BENEFITS OF DISPERSANT USE**

- Dispersant use minimizes the effects of an oil spill principally by dispersing oil before it reaches shorelines or sensitive areas (*e.g*.,wetlands, estuaries).
- Removing oil from the surface of the water reduces the potential for impacts to birds and marine mammals, and limits the action of wind on spill movement.
- Dispersants can prevent oil from sticking to solid surfaces, and enhance natural degradation.
- Dispersants can effectively treat large spills more quickly and inexpensively than most other response methods.
- Dispersants can be effective in rough water and strong currents where mechanical responses are limited.
- Effective dispersant responses can greatly reduce the quantity of oil requiring recovery and disposal.
- Dispersant use is often the only feasible response to spills that exceed mechanical response capabilities.
- Dispersant use does not generally limit other options, except oleophilic mechanical responses.
- Dispersed oil that cannot be mechanically recovered generally poses few significant environmental problems.

From Cawthron, 2000

BOX 1a **DEPLOY SMART**

Immediately deploy USCG Strike Team SMART to the spill site if dispersant use is likely. Every attempt should be made to implement the on-water component of the SMART monitoring protocols in every dispersant application. Dispersant application should not be delayed should sea conditions, equipment failure, or other unavoidable circumstances preclude the positioning of monitoring equipment and personnel. At a minimum, Tier 1 (visual) monitoring must occur during any dispersant operation approved in accordance with this California Dispersant Plan. Tier 2 (on-site water column monitoring) and Tier 3 (fate and transport of the dispersed oil) SMART monitoring will be deployed as appropriate. Other information on monitoring dispersant effectiveness, including additional SMART background information, tools and report forms, is presented in Appendices D.4 – D.8.

Decision: Deploy SMART?

			Date	Time
❒	Yes	Use contact information in Appendix A. Go to **Box 1b**.	………	………
❒	No	Note reason why not deployed. ………………………………………………	………	………
		………………………………………………		

Go to **Box 1b** or **Box 1c** as appropriate.

BOX 1b **PLACE AERIAL WILDLIFE OBSERVERS ON STANDBY OR DEPLOY THEM TO IMPLEMENT THE *WILDLIFE SPOTTING PROTOCOLS***

Consider deploying trained wildlife spotters in initial spill overflight aircraft so that they can determine if the presence of marine animals in the spill or dispersant application zones could influence spray pattern decisions by the FOSC. The goal is to minimize over-spray onto unaffected animals. Wildlife spotters should use the forms and procedures given in the *Wildlife Spotting Protocols* (Appendix D.9 and Appendix E). The FOSC will decide how subsequent and systematic wildlife spotting efforts can be safely conducted with the aerial resources available.

Decision: Notify/deploy aerial wildlife spotters?

			Date	Time
❒	Yes	Use wildlife spotter contact information in Appendix E.2. Go to **Box 2**.	………	………
❒	No	Note reason why wildlife spotters not deployed ……………………………… …………………………………………………………………………………	………	………

Reconsider under **Box 8**.

BOX 1c **ASSESS OTHER RESPONSE OPTIONS**

Consider all response options to identify which option, or combination of options, is most appropriate. The following options are described in Section 4500 of the Area Contingency Plan.

- No action other than monitoring
- Mechanical containment and recovery of oil at sea
- Clean-up of oil from shorelines
- *In situ* burning

Decision: Assess other response options?

			Date	Time
❒	Yes	Determine and implement most appropriate response.	………	………
❒	No	Monitor the spill as a minimum response option.	………	………

From Cawthron, 2000

BOX 2 **CAN SPILLED OIL BE CHEMICALLY DISPERSED WITH AN APPROVED AND AVAILABLE AGENT ON BOTH THE NCP PRODUCT LIST AND THE STATE OSCA LICENSING LIST?**

A NCP Product List may be found in Appendix H. Updated NCP Product Lists can be accessed via the EPA representative on the RRT (Appendix A), by calling the Emergency Response Division of the U.S. EPA (202-260-2342) or accessing the internet at http://www.epa.gov/oilspill/ncp/dsprsnts.htm

The State OSCA licensed dispersants may be found in Appendix I or by calling the State OSPR representative on the RRT (Appendix A).

Decision: Can this oil be dispersed with an approved and available agent?

			Date	Time
❒	Yes	Go to **Box 3.**	………	………...
❒	No	Go to **Box 1c**	**………**	**………**

Taken in part from Cawthron, 2000

Discussion Note 2.1 **OIL DISPERSIBILITY**

Three types of oils are typical of those produced or transported in California offshore waters: a) crude oils produced in California Outer Continental Shelf (OCS) waters; b) oils imported from Alaska and foreign countries into California ports; and c) fuel oils that could be spilled from a variety of marine industrial activities (*e.g.*, fuel tanks from ships, cargoes of small tankers). Dispersants only work if the spilled oil has a relatively low viscosity at the time of treatment.

Appendices C.1 and C.2 show the California platform-produced oils and tankered oils, respectively.

Most oils produced from offshore platforms are heavy, and border on the range of oils that are considered to be difficult or impossible to disperse. The oils transported by tanker include two-three dozen different types of oil (only the most common are listed in Appendix C.2). The most important is Alaska North Slope crude, which represents 50% of each annual total. Based on API gravity information, these oils appear to be dispersible when fresh.

- The most important criterion for dispersant use is whether the oil is dispersible.
- The best indication of oil dispersibility is from specific oil weathering and dispersion data from field trials (see Appendix C.3 for some tested and modeled oils).
- Potential dispersibility can be *estimated* from physical properties of oils, under different oil weathering and spill scenarios (*e.g.*, ADIOS, Table 2.1 below). The ADIOS computer database predicts oil dispersion based on physical and chemical properties of spilled oil under specified spill conditions.
- Dispersant use should not be rejected exclusively on the basis of predictive models.

Generally, if:

- Oil is able to spread on the water, it is likely to be dispersible.
- Viscosity is 2000 cSt, dispersion is probable.
- Viscosity is >2000 cSt, dispersion is possible.
- Viscosity is >5000 cSt, dispersion is possible with concentrated dispersant (*e.g.*, Corexit 9500).
- Sea temperature is >10º C below oil pour point, dispersion is unlikely.

Potential dispersion may also be assessed using tables in Appendix C.

Limitations of predicting dispersion:

- Using generic values of viscosity and/or pour point to predict dispersion (*e.g.*, ADIOS, Appendices C.3 and C.4) can underestimate the potential for oil to be dispersed.
- Most models are based on limited oil weathering, emulsification or dispersion data, therefore estimated windows of opportunity may be inaccurate.

Table 2.1 **ADIOS (AUTOMATED DATA INQUIRY FOR OIL SPILLS) COMPUTER DATABASE**

Use the **DISPERSANT PRE-APPROVAL ASSESSMENT FORM** and the NOAA SSC (206-321-3320) for the information needed by ADIOS, or use the form below. The NOAA SSC should also be able to assist with ADIOS.

Copies of ADIOS are available from the NOAA website:
http://response.restoration.noaa.gov/software/adios/adios.html

Oil/product name:	_____________		Wind speed:	_____________	(knots)
Amount spilled:	_____________	(gal or bbl)	Wave height:	_____________	(m)
Type of release:		Circle one	Water temp.:	_____________	(ºC)
❑ Instantaneous			Water salinity:	_____________	(ppt)
❑ Continuous					

Important limitations on the use of ADIOS: ADIOS predicts dispersibility based on estimates of oil properties (including emulsification) under different conditions. As emulsification data are scarce, **predicted rates of dispersion may be different than actual rates of dispersion**. ADIOS is intended for use with floating oils only, and does not account for currents, beaching or containment of oil. ADIOS is unreliable for very large or very small spills. It is also unreliable when using very high or very low wind speeds in modeling the spill.

From Cawthron, 2000

BOX 3 **ARE OCEANOGRAPHIC AND/OR WEATHER CONDITIONS POTENTIALLY CONDUCIVE TO DISPERSANT USE?**

Does the available technical information indicate that the existing oceanographic (*e.g.*, surface current direction and speed, wave and chop height) and weather (*e.g.*, wind direction and speed, visibility, ceiling height) conditions are suitable for a successful dispersant application?

Use the following resources:

❒ Information on the DISPERSANT PRE-APPROVAL ASSESSMENT FORM
❒ Consultation with the NOAA Scientific Support Coordinator (206-321-3320)
❒ Information resources and web sites noted in Appendix A
❒ Information from aerial overflights
❒ Information from ADIOS

Decision: Are ocean and weather conditions suitable for a dispersants application?

		Date	Time
❒ Yes	Go to **Box 4**.	……….	….…...
❒ No	Go to **Box 1c**	……….	………

BOX 4 **IS THE SPILLED OIL AT LEAST 3 MILES FROM SHORE AND NOT WITHIN NMS BOUNDARIES?**

A full-page statewide chart indicating the area three nautical miles from shore and the areas within National Marine Sanctuaries (Gulf of the Farallones, Cordell Banks, Monterey, Channel Islands) is in Chart 4.1 below. Regional charts, with pre-approval dispersant zones noted, are in Appendix B.

Plot the position of the spill on the appropriate nautical chart, draw a circle around the spill source with a 10 nautical mile radius as a worst-case scenario for surface movement. Hash mark any area within the circle that is in waters 3 nautical miles from shore or within a National Marine Sanctuary. What is left is considered the dispersant operational area.

Decision: Is the spilled oil within a Pre-Approval zone?

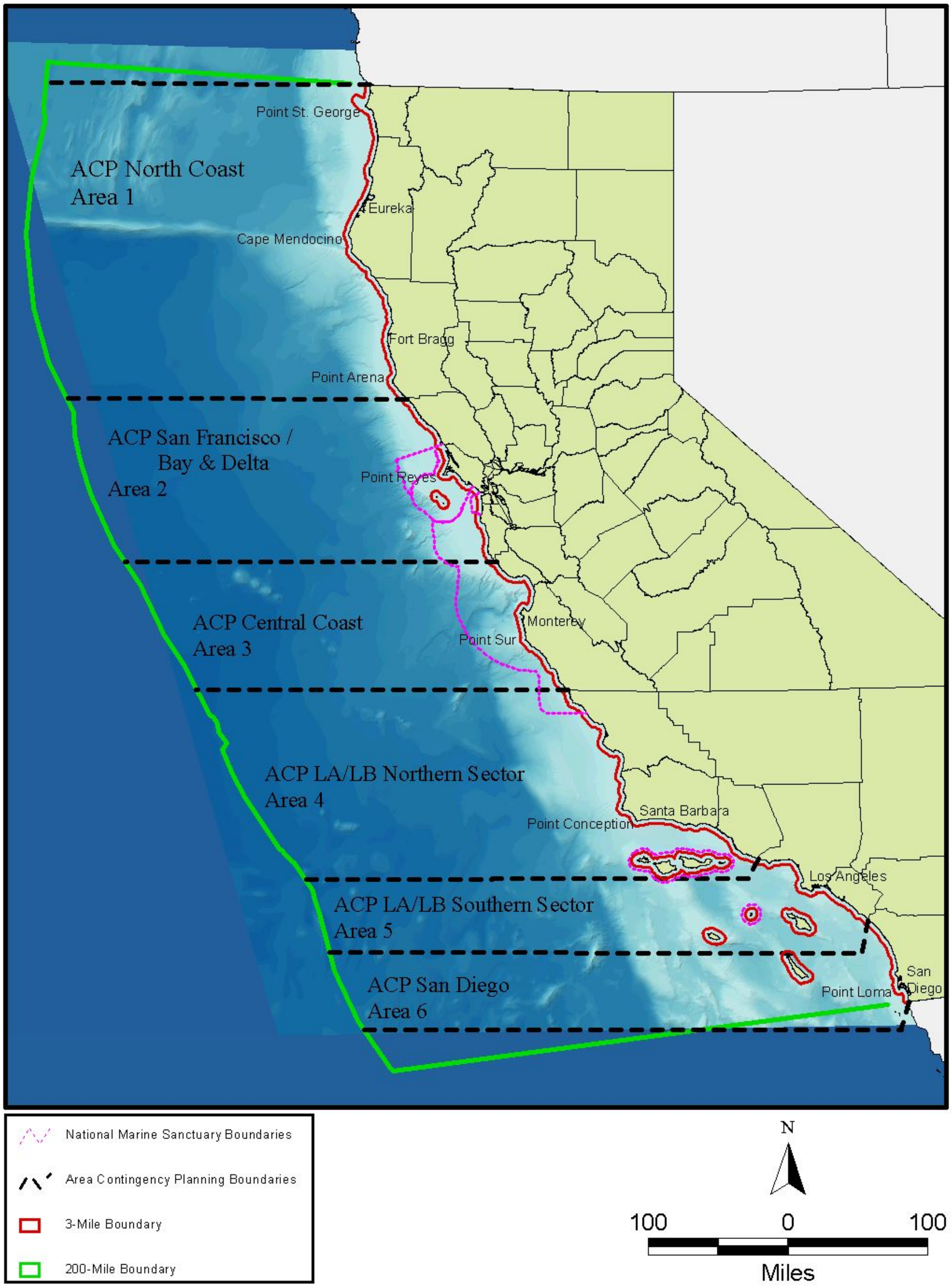
		Date	Time
❒ Yes	Go to **Box 5**.	……….	……….
❒ No	Pre-Approval does not apply. Go to **Box 4a**.	……….	……….

BOX 4a **PRE-APPROVAL DOES NOT APPLY; REFER TO RRT APPROVAL PROCESS.**

The request for dispersant use does not qualify under the pre-approval guidelines for the use of dispersants in RRT Regional IX. Contact the NOAA SSC (206-321-3320) and begin the dispersant RRT Approval Process, Appendix J.

Chart 4.1

California Marine Waters Pre-Approval Dispersant Zone



BOX 5 **WILL DISPERSANT USE HAVE A NET ENVIRONMENTAL BENEFIT?**

Use the regional sensitive species and habitat information from Appendix B for each major coastal area in which dispersant use may have an impact.

Consider:

- ❒ The type and value of habitat potentially affected.
- ❒ The sensitivity of affected resources to oil, and to different oil response strategies.
- ❒ Natural recovery rates of affected species and habitats.
- ❒ Likely oil persistence and degradation rates with and without dispersant use.
- ❒ Potential oil toxicity on surface water species compared to water column and/or seafloor species.

Dispersant use is generally not appropriate in areas with limited water circulation and flushing, near aquaculture facilities, shellfish beds and fish-spawning grounds, and around seawater intakes.

Decision: Will the dispersant use have a net environmental benefit?

		Date	Time
❒ Yes	Go to **Box 6**	……….	……….
❒ No	Go to **Box 1c**	……….	……….

In part from Cawthron, 2000

Discussion Note 5.1 **ASSESSING NET ENVIRONMENTAL BENEFIT**

The most important question to answer is: **Will dispersant use significantly reduce the impact of the spilled oil?**

- Rapid decisions on use are essential as dispersant must be applied quickly to be effective.
- Decision-makers must consider the various environmental, social, economic, political and cultural factors unique to each spill.
- Tradeoffs will be necessary, as no response is likely to satisfy all parties and protect all resources. The ecological impacts of oil are generally longer-lasting and more persistent than most other impacts.
- Ecological effects will be due primarily to the spilled oil. Dispersant applied at recommended rates is unlikely to cause significant adverse effects, even in multiple applications.
- Oil dispersed into water depths greater than 10m will quickly dilute to levels where acute toxic effects are unlikely.
- Few acute toxic effects have been reported for crude oil dispersed into less than 10m of well-flushed water.
- Small spills of light fuels seldom require dispersant use.

From Cawthron, 2000

BOX 6 CAN DISPERSANT BE APPLIED SAFELY FROM AN APPROPRIATE PLATFORM?

Use the information in the **DISPERSANT PRE-APPROVAL ASSESSMENT FORM** to evaluate which application platform(s) will be most effective, given the following particular considerations:

- The amount of oil spilled;
- The location of the operational area;
- The volume of available dispersants;
- The timeframe in which the required equipment can be on-scene.

Assume for planning purposes that the weather information on the **DISPERSANT PRE-APPROVAL ASSESSMENT FORM** will remain the same during the timeframe in which this decision is operating. At the earliest opportunity, contact the NOAA SSC (206-321-3320) for more detailed and updated weather information, but do not delay this decision process for the NOAA SSC weather input. Weather information may also be available from resources noted in Appendix A. See Appendices C.5 – C.8 for specific information on dispersant application platforms.

Decision: Is there a safe and appropriate application platform for a dispersant operation?
(See Discussion Note 6.2 below for important safety information)

	Yes	(Type)	No	(Why not appropriate?)	Date	Time
C-130/ADDS Pack	☐		☐	....	....	....
DC-4	☐		☐	....	....	....
Other large multi-engine airplane	☐	....	☐	....	....	....
Cessna AT-802	☐		☐	....	....	....
Other single-engine airplane	☐	....	☐	....	....	....
Helicopter	☐	....	☐	....	....	....
Work boat	☐	....	☐	....	....	....
	Go to **Box 7**		Go to **Box 6a**			

Taken in part from Cawthron, 2000 and S.L. Ross, 2002

Discussion Note 6.1 CURRENT LOGISTICS FOR A CALIFORNIA DISPERSANT APPLICATION

Use the information on the **DISPERSANT PRE-APPROVAL ASSESSMENT FORM** to consider the following:

❒ Is the selected dispersant available in the quantity needed?
❒ Can the estimated "window of opportunity" for getting the dispersant on the oil be met?
❒ Can the dispersant and application resources get to the spill scene on time?
❒ Will there be enough daylight hours for an effective dispersant application?

Refer to Appendix C for more specific regional dispersant resource information.

Discussion Note 6.2 **GENERAL SAFETY ISSUES**

- The FOSC is responsible for ensuring that health and safety requirements are adequately addressed during a response.
- Individuals should not engage in activities that they are not appropriately trained to perform.
- Individuals are expected to adhere to safety procedures appropriate to the conditions they are working under and/or are included in a dispersant-specific Site Safety Plan.
- Vessel/aircraft operators are expected to define appropriate operational limits and safety and maintenance requirements for their craft.
- Aircraft should be regularly washed with fresh water to remove any dispersant and salt water, particularly from the tail rotor assembly of helicopters or exposed rubber components of aircraft controls.
- Apply dispersants only if there is no significant risk to response personnel (*e.g.*, ignition risk, operational hazards).
- Ensure the appropriate personal protective equipment (PPE) is available.
- Ensure that application aircraft and vessels remain within standard operating limits.
- Each person involved in a response is required to take personal responsibility for his or her safety. The FOSC may appoint a Safety Officer and request development of a specific Site Safety Plan. Key safety aspects to be considered in the plan may include:
  - Physical hazards (*e.g.*, waves, tides, unstable or slippery surfaces)
  - Heavy machinery and equipment
  - Chemical hazards (*e.g.*, oil and dispersant exposure)
  - Atmospheric hazards (*e.g.*, fumes, ignition risks)
  - Confined spaces
  - PPE
  - Noise
  - Fatigue
  - Heat/cold stress
  - Wildlife (bites/stings)
  - Cleanup facilities
  - Medical treatment

HUMAN SAFETY OVERRIDES ALL OTHER CONSIDERATIONS DURING A RESPONSE

From Cawthron, 2000

BOX 6a **DISPERSANT OPERATIONS ON WEATHER STANDBY**

Consult with appropriate RRT IX members (USCG/District 11 Co-Chair, EPA, DOI, DOC and OSPR (See Appendix A for contact information) to notify them that dispersants are being considered, but delayed due to weather.

Decision: **Has the weather improved to the point where dispersants can be applied?**

		Date	Time
❒ Yes	Go to **Box 7**	……….	……….
❒ No	Continue to **reassess** (until/unless time window for successful application closed) <u>or</u> Go to **Box 6b**	……….	……….

BOX 6b **WEATHER UNLIKELY TO IMPROVE OR SUITABLE RESPONSE RESOURCES NOT AVAILABLE**

There will be spill situations where dispersant use may be appropriate but weather conditions and available resources will not allow dispersants to get on the oil within the appropriate weather window. In these cases, dispersant use will need to be abandoned and other response options considered instead.

Go to **Box 1b** | Date .... | Time ....

BOX 7 **DISPERSANT USE MAY BE APPROVED**

DISPERSANTS APPROVED FOR USE BY THE FOSC NEED TO BE APPLIED USING THESE RRT IX GUIDELINES:

- ❒ Pre-approval zones are <u>only</u> in waters no closer than 3 nautical miles from the nearest shoreline and not within the boundaries of a National Marine Sanctuary.
- ❑ Dispersants cannot be applied to any diesel spill in the San Diego Area Contingency Plan area.
- ❒ The SMART controller/observer should be over the spray site before the start of the operation. If possible, a DOI/DOC-approved marine mammal/turtle and pelagic/migratory birds observation specialist (see Appendix E.2 for list) will accompany the SMART observer. However, the operation will not be delayed for either function.
- ❒ The marine wildlife observer, or the person functioning as that observer, is very strongly encouraged to use the Wildlife Observation Report Form (Appendix D.9) and the Wildlife Spotting Protocols (Appendix E).
- ❒ Personnel protective equipment for personnel on-site will conform to the appropriate dispersant's Material Safety Data Sheet (MSDS).
- ❒ Dispersant application aircraft will maintain a minimum 1000-foot horizontal separation from rafting flocks of birds. Caution will be taken to avoid spraying over marine mammals and marine turtles (see Appendix A for resource agency contact information).
- ❒ If the dispersant application platform is a boat:
  - The following ASTM standards apply to systems involving spray arms or booms that extend over the edge of the boat and have fan-type nozzles that spray dispersant in a fixed pattern:
    - <u>ASTM F 1413-92</u>: Standard Guide for Oil Spill Dispersant Application Equipment: Boom and Nozzle Systems
    - <u>ASTM F-1460-93</u>: Standard Practice for Calibrating Oil Spill Dispersant Application Equipment Boom and Nozzle Systems
    - <u>ASTM F 1737-96</u>: Standard Guide for use of Oil Spill Dispersant Application Equipment During Spill Response: Boom and Nozzle Systems.
  - Boat-based systems using a fire monitor and/or fire nozzle shall avoid a straight and narrow "firestream" flow of dispersant directly into the oil. There are no applicable ASTM standards for these systems at this time (December 2003).

BOX 7a **INITIATE *PUBLIC COMMUNICATIONS PLAN***

Once a decision to use dispersants is made, it is critical that a public communications plans be implemented (Appendix F). The general public as well as stakeholders must be made aware of any decision to use dispersants and a mechanism created for reliable and continuous updates.

An initial press conference should be held which outlines the decision to use dispersants, provides background and scientific information, and addresses any other environmental and safety considerations expressed by the public. A sample press release is in Appendix F.1, with other public meeting and risk communication tips offered throughout Appendix F.

A public meeting should be scheduled as soon as possible to provide a mechanism for sharing information and addressing public concerns and fears. Appendix F provides guidelines for preparing and conducting a public meeting. Areas that must be adequately addressed during the meeting include:

- Seafood tainting concerns posed by dispersants (Appendix G).
- Risk communication (Appendix F.2 and Appendix G).
- Results of net environmental benefit analyses, and species of special concern (summarized in Appendix B).
- Monitoring policies established for the spill (tools used from Appendix D).

BOX 8 **IMPORTANT SUPPLEMENTAL INFORMATION TO CONSIDER**

This FOSC Checklist applies only to those California offshore waters pre-approved for dispersant use (waters 3 – 200 nautical miles from shore and not within a National Marine Sanctuary); see **Box 4**. However, dispersant use even in the pre-approval areas must follow certain guidelines (**Box 7)** and may be further limited by federal agencies with responsibility for endangered marine animal management (Appendix L).

Pre-approval dispersant zone recommendations do not presume the absence of sensitive species, other marine species, or impacts to species on the water surface or in the upper water column. It does presume that there will be impacts from the spilled oil, and from dispersant use, to some of those species. However, based on the natural resource information used in the planning stage, it was determined that there could be a net environmental benefit (**Box 5**) to the use of dispersants.

However, at the time of an actual spill and a decision to use dispersants, real-time information on marine animal presence (**Box 1b** and **Box 8a**), the potential impacts from the spill (DISPERSANT PRE-APPROVAL ASSESSMENT FORM), and important supplemental information (Appendix B and **Box 8c**) should all be considered and weighed by the FOSC in making a final decision to use dispersants, probable impacts, and where the net environmental benefits will occur.

BOX 8a **MARINE ANIMALS INFORMATION FROM AERIAL WILDLIFE SPOTTERS**

The FOSC can take additional information and advantage from the Aerial Wildlife Observers if they have been deployed (**Box 1b**), or information from the Wildlife Aerial Survey Form (Appendix D.9) available from other aerial spotters, or information from wildlife spotters (Appendix E.2) available to the FOSC from other data collection forms or notes used by those spotters. Any of these resources will provide real-time or near real-time information on marine seabird and mammal presence, and can guide the FOSC on dispersant application parameters that may minimize impacts to those resources.

BOX 8b **REGIONAL SENSITIVE SPECIES AND HABITAT INFORMATION FROM NEBA**

At the time of an actual oil spill or a decision to use chemical dispersants on the oil, marine species are expected to be on the water surface or in the upper water column. Before using chemical dispersants, the FOSC will have decided that there may be a net environmental benefit from dispersant use. Information on regional sensitive species and habitat information from the Net Environmental Benefit Analyses (NEBA), summarized for each region in Appendix B, can help the FOSC determine which species might actually be in the area and scouted for by the aerial observers (**Box 1b** and **Box 8a**). This additional information can provide further validation and justification to a FOSC that impacts of chemical dispersant application will be minimized wherever possible, and net environmental benefit maximized.

BOX 8c **CONSULT *SEAFOOD TAINTING PLAN***

Refer to Appendix G for key points to consider regarding seafood tainting, as well as information on accessing NOAA and state resources for assessing the tainting risk.

BOX 9 **APPLY DISPERSANTS AND INFORM RRT**

- ❑ Use the information on <u>estimated oil spill volume</u> from the DISPERSANT PRE-APPROVAL ASSESSMENT FORM and Discussion Note 9.1 below to:
  - Determine the dispersant application ratio (usually 1:20), and
  - Calculate the volume of dispersant required (Appendices D.1 and D.2).
- ❑ Record the details on the Dispersant Application Summary Form (Appendix D.4);
- ❑ Mobilize application team;
- ❑ If not already done, mobilize SMART. Some blank SMART forms are included in Appendix D for use by other trained professionals, if appropriate and when approved by the FOSC.
- ❑ Inform RRT (see Appendix A for contact information).

Decision: Dispersants applied?

		Date	Time
❑ Yes	Go to **Box 10**.	....	....
❑ No	Explain.	....	....

Discussion Note 9.1 **GENERAL APPLICATION INFORMATION**

- The FOSC has final responsibility for operational aspects of dispersant applications.
- Dispersant must only be applied by experienced spray applicators and in accordance with manufacturer instructions.
- The persons applying dispersant are responsible for the calibration and operation of the spraying system, and the safety and maintenance of the application platform.
- Droplet size is the key variable influencing dispersant effectiveness. Undersized droplets (*e.g.*, fog or mist) will be lost through drift and evaporation. Oversized droplets will punch through the oil and be lost in the water column.
- Dispersants pre-diluted in water are less effective than undiluted dispersant.
- Only undiluted concentrate dispersant is applied from aircraft. Dispersant should, where possible, be applied into the wind and parallel with the slick.
- Dispersant should be applied in a methodical and continuous manner to ensure the entire target area is treated.
- Spraying effort should concentrate on the thickest sections, and/or the leading edges, of oil that threaten sensitive areas.
- Thick portions of the slick may require several applications.
- Oil sheen should not be sprayed with dispersant.

Regarding the relationship between Dispersant-to-Oil Ratio (DOR) and the concentration of oil being treated:

- Regardless of DOR ratios suggested by dispersant manufacturers, there are many factors that influence dispersability (*e.g.*, oil characteristics, degree of weathering, water salinity, sea state) that may make it very difficult to select an appropriate DOR for the conditions faced on the day of a specific spill
- The variability of slick thickness (or oil concentration) is such that one can never really characterize the actual oil concentration for more than a few seconds within the speed and swath constraints of a particular application system.
- With most application systems, one is usually overdosing and underdosing as the system moves through light, heavy and sometimes “no” oil on the water surface.
- The best estimate of the average oil thickness (or average volume of oil per unit are) must be used.
- Given that precise spray parameters are extremely difficult to achieve, dispersant applicators generally use about 5 gallons of dispersant per acre on their first run.
- Area, volume and thickness can be related with the following expression:

$$\mathbf{10^4 \text{ x Area (hectare) x Thickness (mm) = Volume (liters)}}$$

or

$$\mathbf{\text{Volume (liters/Area (hectares) = } 10^4 \text{ x Thickness (mm)}}$$

►To convert liters/hectare to gallons/acre, multiply by 0.107. To convert liters/hectare to gallons/square kilometer, multiply by 26.42.
►These values (in any units) multiplied by the DOR (as a fraction, *e.g.*, 1:5 = 1/5 or .2) will then yield the Desired Dosage (in those units) for that value of DOR.
►Refer to Appendix D.1 for some pre-calculated values.

From Cawthron, 2000 and Al Allen (Spilltec), 2003 personal communication

Discussion Note 9.2 **AERIAL APPLICATION**

This general aerial application guide is intended simply to highlight key issues. The FOSC will coordinate and oversee operational aspects of aerial dispersant applications.

- Aircraft applications should always include pump-driven spray units.
- Dispersant droplet size should be between 400 and 1000 microns.
- Commercial aircraft spray nozzles generally range between 350 and 700 microns.
- 1000-micron spray nozzles may be needed for use on viscous oils.
- Nozzles should achieve an application rate of 5.3 gallons per acre if using a 1:20 ratio.
- Spray nozzles should be installed to discharge directly aft.
- Underslung buckets on helicopters should be mounted so the pilot can see the ends of the spray booms in flight.
- The altitude of the aircraft should be as low as possible.

From Cawthron, 2000

Discussion Note 9.3 **BOAT APPLICATION**

- Spray booms should be mounted as far forward as possible to prevent oil being moved aside by the bow wave before being sprayed. This then uses the mixing energy of the bow wave to break up the oil.
- Spraying systems should be set so that the spray pattern is flat, striking the water in a line perpendicular to the direction of the boat's travel.
- The fan-shaped sprays from adjacent nozzles should be set as low as possible, overlapping just above the oil/water surface, with the inboard spray striking the hull just above the waterline.

Undiluted dispersants

- Air blast sprayers and modified spray pumps can be used to apply undiluted concentrated dispersants and conventional dispersants.
- Treatment rate is usually constant and determined by nozzle size and spray pressure.
- Calibration and use of an appropriate droplet size is critical to effective applications.

Pre-diluted dispersants

- Concentrated dispersants can be applied after pre-dilution in seawater, but will be less effective.
- The dispersant : water ratio should be equal to, or greater than, 10%
- Applications through ship's fire-fighting equipment are controlled by opening or closing the dispersant supply. Vessel speed is used to control the treatment rate.
- Dual pump systems for dispersant and seawater-supplying spray booms allow the dilution rate to be adjusted.
- Boat speed is the main determinant of dispersant dose rate (reduce boat speed to increase the dose rate).
- Boat speed should be in the order of 5 knots for fresh spills of liquid crude or fuel oil, which assumes that the oil has spread to 0.1 mm thick.
- With reduced boat speeds, the required application rate per acre or km^2 can be maintained by reducing pump speed.

From Cawthron, 2000

BOX 10 **IS THE DISPERSANT EFFECTIVE?**

- ❑ Acquire information from dispersant monitoring team (SMART team or other FOSC-designated monitors).
- ❑ Review dispersant monitoring results after each dispersant application.
- ❑ Determine if dispersant application is effective.
- ❑ Determine if chemical dispersion is significantly greater than natural dispersion.
- ❑ Assess whether changing application parameters could make the application more effective.

Decision: Is the dispersant effective?

			Date	Time
❑	Yes	Go to **Box 11**	....	....
❑	No	❑ See Discussion Note 10.2 and return to **Box 9**, or	....	....
		❑ Go to **Box 12**	....	....

From Cawthron, 2000

Discussion Note 10.1 **ASSESSING DISPERANT EFFECTIVENESS**

- Dispersant applications must be monitored to confirm whether or not dispersant use is effective, and to determine the fate and transport of treated oil.
- Dispersant applications should not be delayed simply because monitoring is not in place.
- Visual observation is the minimum level of monitoring. Observations teams may use the forms in Appendix D.
- There will be very few instances where a dispersant application is possible but visual monitoring is not.
- Because dispersed oil plumes are often highly irregular in shape and thickness, it can be difficult to accurately estimate dispersant efficiency.
- The appropriate dispersant application dose depends on the oil thickness (see Appendices D.1 and D.2 for common dose rates based on oil thickness). Slicks are generally not of uniform thickness, and it is not always possible to distinguish among thicker and thinner portions of the same slick. It is therefore possible to apply too much or too little dispersant to some parts of a slick. Because over- and under-dosing can lead to variations in effectiveness, these variations should be noted.
- On-site monitoring of oil dispersed in the water column should support visual monitoring whenever possible. See Appendix D for additional information and forms.
- Decisions to terminate operations due to poor effectiveness should ideally be based on on-site monitoring results.
- A visible coffee-colored cloud in the water column indicates the dispersant is working.
- A milky-white plume in the water column can indicate excessive dispersant application.
- When dispersant is working, oil remaining on the water surface may also change color.
- A difference in the appearance of treated and untreated slicks indicates dispersion is likely.
- Absence of a visible cloud in the water column makes it difficult to determine whether the dispersant is working. When the water is turbid, you may not be able to see a plume. Oil remaining at the surface and sheens can also obscure an ability to see oil dispersing under the slick.
- Successful dispersion can occur with no visible indication of dispersion.
- A subsurface plume may not form instantly once dispersant has been applied. In some cases (*e.g.*, emulsified oil) it can take several hours for a plume to form. In other cases, a visible plume may not form, and you may wish to use sampling to learn whether dispersion has occurred.
- Boat wakes may physically part oil, falsely indicating successful dispersion. Mechanically dispersed oil will re-coalesce and float to the surface.
- Dispersants sometimes have a herding effect on oil after initial applications, making a slick appear to be shrinking when, in fact, the dispersant is “pushing” the oil together. The effect results from the surfactants in the dispersant, which causes a horizontal spreading of thin oil films. This can cause parts of a slick to seem to disappear from the sea surface for a short time.

From Cawthron 2000 and NOAA Oil Spill Job Aids

Discussion Note 10.2 **WHEN DISPERSANT IS NOT EFFECTIVE**

If monitoring shows dispersion does not appear effective, review all aspects of the application and monitoring for possible reasons why. Aspects to consider include:

- Dispersant formulation
- Application ratios (increase or decrease oil: dispersant ratio)
- Application methods
- Monitoring methods
- Interpretation of monitoring results
- Oil weathering
- Weather conditions

From Cawthron, 2000

BOX 11 **IS ONGOING DISPERSANT USE JUSTIFIED AND SAFE?**

All of the following must apply to justify ongoing dispersant use:

- ❑ The spill can be chemically dispersed with an approved and available agent (see **Box 2** and Appendices H and I);
- ❑ Oceanographic and weather conditions are potentially conducive to dispersant use (see **Box 3** and DISPERSANT PRE-APPROVAL ASSESSMENT FORM);
- ❑ The spilled oil is at least 3 nautical miles from shore and not within the boundaries of a National Marine Sanctuary (see **Box 4**);
- ❑ The dispersant will have a net environmental benefit (see **Box 5**);
- ❑ The dispersant can be applied safely (see **Box 6**), with suitable weather (**Box 6a**) and available resources (**Box 6b**);
- ❑ The dispersant is effective (see **Box 10**).

Decision: Continue with dispersant use?

		Date	Time
❑ Yes	Go to **Box 9**	....	....
❑ No	Go to **Box 12**	....	....

THERE WILL BE A POINT WHEN THE USE OF DISPERSANT IS NO LONGER EFFECTIVE.

BOX 12 **DO NOT USE DISPERSANT**

Pre-approval to use dispersants does not apply if **any** of the following occur:

- ❑ The spill cannot be chemically dispersed with an approved and available agent (see **Box 2** and Appendices H and I);
- ❑ Oceanographic and weather conditions are not potentially conducive to dispersant use (see **Box 3** and DISPERSANT PRE-APPROVAL ASSESSMENT FORM);
- ❑ The spilled oil is closer than 3 nautical miles from shore or within the boundaries of a National Marine Sanctuary (see **Box 4**). Approval to use dispersants within 3 miles or within a National Marine Sanctuary does not fall within the Pre-Approval guidelines, and will instead need to be considered under the RRT Approval Process (see **Box 4a** and Appendix J);
- ❑ The dispersant will not have a net environmental benefit (see **Box 5**);
- ❑ The dispersant cannot be applied safely (see **Box 6**), with suitable weather (**Box 6a**) or available resources (**Box 6b**);
- ❑ The dispersant is not significantly more effective than natural dispersion or other response options (see **Box 10**).

IF DISPERSANT USE IS CONSIDERED INAPPROPRATE, CONSIDER OTHER RESPONSE OPTIONS.

Go to **Box 1a**.

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Wildlife Response Plan Appendices of the California Area Contingency Plan. Version 2, October 2003.

Yender,R., J. Michel, and C. Lord. 2002. Managing Seafood Safety After an Oil Spill Seattle: Hazardous Materials Response Division., Office of Response and Restoration, National Oceanic and Atmospheric Administration. 72 pp.

Resources from Internet World Wide Web sites:

NOAA Oil Spill Job Aids
(web links of 12/18/03)

http://response.restoration.noaa.gov/job_aid/glossary.html
http://resposne.restoration.noaa.gov/oilaids/spiltool
http://response.restoration.noaa.gov/disp_aid/remember.html
http://response.restoration.noaa.gov/disp_aid/checklist.html
http://response.restoration.noaa.gov/oilaids/OilatSea.pdf
http://response.restoration.noaa.gov//oilaids/SMART/SMART.html

APPENDIX A

CONTACT NUMBERS AND RELEVANT WEB SITES

A.1 Agencies and Institutions

	Web Address	Phone
To Report Marine Pollution/Spills		800-424-8802
California Office of Emergency Services		800-852-7550
U.S. Coast Guard		
Marine Safety Offices		
San Francisco	http://www.uscg.mil/d11.msosf	510-437-2956
Los Angeles-Long Beach	http://www.uscg.mil/d11/msogrulalb	310-732-2000
San Diego	http://www.uscg.mil/d11/sandiego/mso	619-683-6500
Weather and surf		619-289-1212
National Oceanic and Atmospheric Administration & NOAA National Weather Service		
Scientific Support Coordinator for California (Heather Parker-Hall)		206-321-3320
Pager		800-759-8888 pin 5798818
Mobile		206-321-3320
Ocean Prediction Center	http://www.mpc.mcep.noaa.gov or http://www.www.nws.noaa.gov	
Tide Predictions and Coastal Water Temperature Guide	http://www.noaa.gov/ocean/html	
Nautical Charts	http://www.noaa/gov/charts/html	
Physical, Chemical and Geological Ocean Data	http://www.nodc.noaa.gov or http://www.ncddc.noaa.gov	
NOAA Trajectories, ESI maps, Job aids, etc.	http://response.restoration.noaa.gov	
National Weather Service – Local Offices and Forecasts		
Eureka	http://www.wrh.noaa.gov/eureka	707-443-6484
SF/Monterey	http://www.wrh.noaa.gov/monterey	831-656-1725
Oxnard/Los Angeles	http://www.nwsla.noaa.gov/buoy.html	805-988-6610
San Diego	http://www.wrh.noaa.gov/sandiego/index.shtml	858-675-8700

APPENDIX A, continued

	Web Address	Phone
Other Measured Currents and Wind Data Sources		
UC San Diego	http://www-ccs.ucsd.edu/oilspill	
Scripps	http://facs.scripps.edu/surf/weatherbody.html	

Regional Response Team (Region 9)

Coast Guard:		
William Fels (RRT 9 Co-Chair)		510-437-5754
Environmental Protection Agency:		
Daniel Meer (RRT 9 Co-Chair)		415-972-3132
Bill Robberson		415-972-3072
Pager		800-759-8888 pin 2832870
Department of Interior:		
Patricia Port		510-817-1477
Department of Commerce:		
Steve Thompson		415-561-6624
State Office of Spill Prevention and Response:		
Mike Sowby		916-324-7629
Pager		916-360-0730
Mobile		916-704-1757
Yvonne Addassi (alternate)		916-324-7626
Pager		916-857-9550
Mobile		916-216-1203

National Marine Sanctuaries

Channel Islands		
24-hour pager		877-982-2617
Ben Waltenberger		805-729-3082
Chris Mobley, CINMS Manager		805-729-0127
Andrea Hrusovsky		805-729-2388
Monterey Bay		
24-hr pager		888-902-2778
Main office phone		831-647-4201

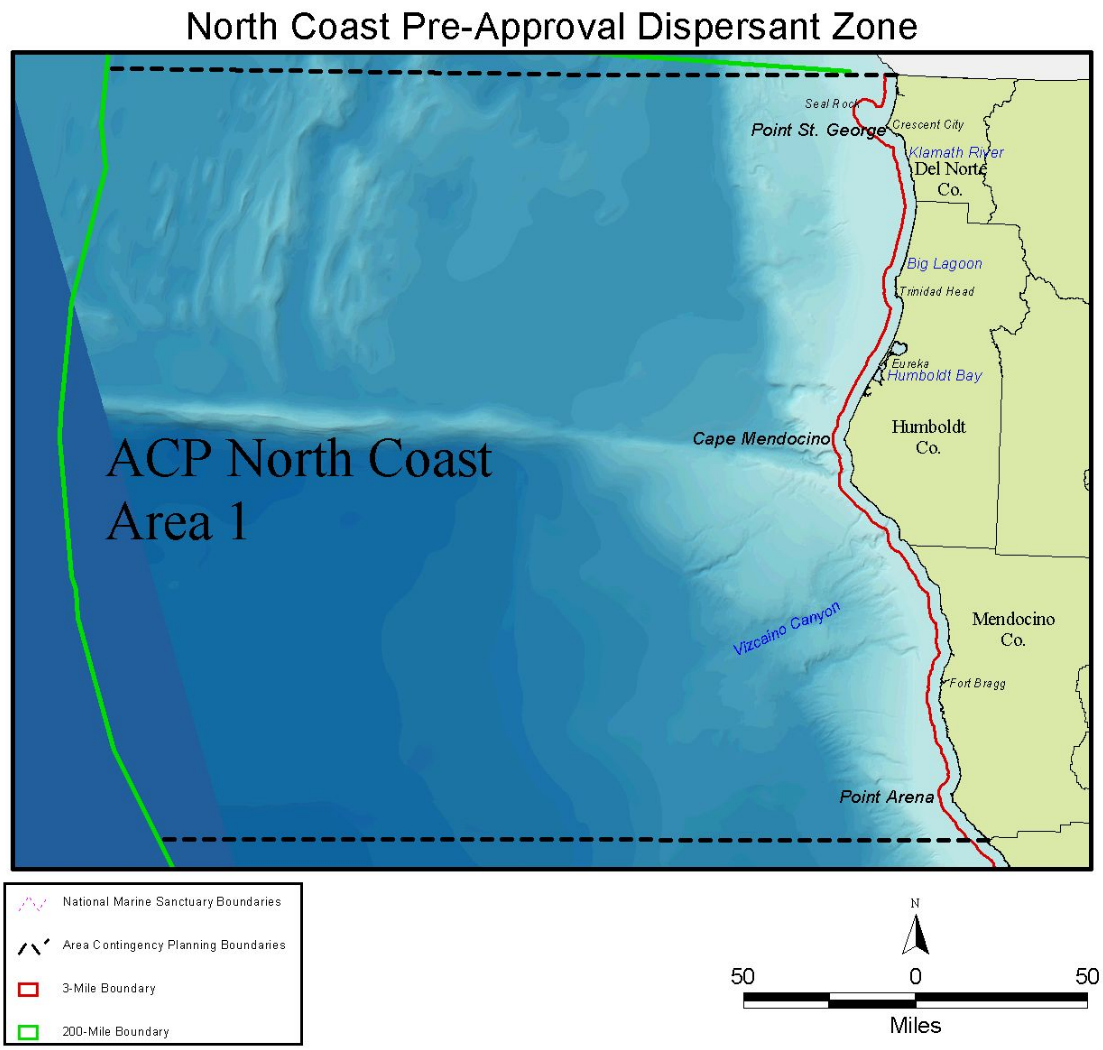
APPENDIX A, continued

	Web Address	Phone
Gulf of the Farallones & Cordell Bank		
Main office phone		415-561-6622
Superintendent (Acting): Maria Brown		415-561-6622 x 301
Alternate: Jan Roletto		415-561-6622 x 207
NMS Washington, D.C.		
Lisa Symons (pager)		800-218-1232

APPENDIX B

PRE-APPROVAL ZONE CHARTS AND REGIONAL WILDLIFE RESOURCE SUMMARIES

B.1 North Coast



The North Coast dispersant use pre-approval area includes all waters seaward of the 3-mile state waters line (shown in red) and shoreward of the 200-mile line (shown in green). Areas inside state waters or within 3 miles of the California-Oregon border are "RRT Approval Required"; RRT approval will be case-specific.

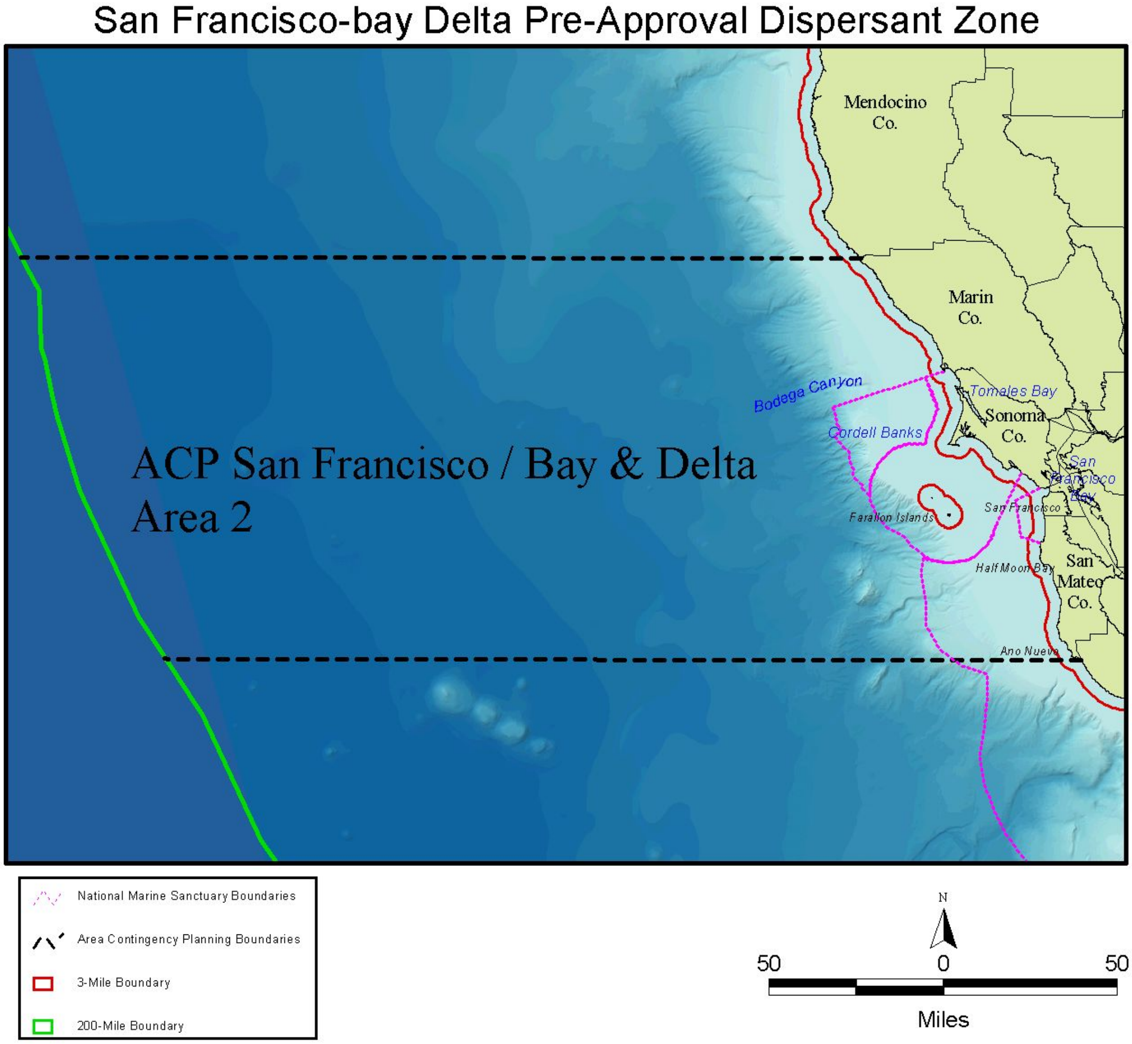
Offshore sea birds are seasonally concentrated in the areas off Point Arena, Cape Mendocino and Point St. George. These include phalaropes, auklets, petrels, shearwaters, fulmars, gulls and murres. Loons, grebes, endangered brown pelicans and marbled murrelets commonly occur inshore. Recent oil spills in the Humboldt Bay region have demonstrated that common murres and marbled murrelets are very susceptible to spilled oil. Shore birds, including the endangered western snowy plover, are also at risk should spilled oil reach the shore.

Many marine mammal species are potentially at risk, including several species of cetaceans (whales, dolphins, porpoises) and pinnipeds (seals and sea lions). Endangered cetaceans include blue, fin, humpback and sperm whales. Heavy oiling of the intertidal and upland areas of the coast can threaten harbor seal, Stellar sea lion and elephant seal pups.

Sensitive marine mammal areas include the slopes and offshore waters over Mendocino Ridge, the Vizcaino Canyon fan (used seasonally by northern fur seals), the Stellar sea lion rookeries at Cape Mendocino and Seal Rock, and the sea lion and harbor seal haul outs on St. George Reef and Trinidad Head. In addition, the waters near St. George Reef, the Klamath River mouth, and Big Lagoon near Trinidad Head support year-round populations of gray whales.

As oil comes ashore, the rocky intertidal habitat, as well as wetlands and mud flats adjacent to river mouths, are at significant risk both from the beached oil and from most of the cleanup procedures used to remove the oil. Of special concern in the marsh/wetland areas are the many species of resident or visiting birds, mammals, young-of-the-year endangered Coho salmon and steelhead trout.

B.2 San Francisco-Bay Delta



The San Francisco-Bay Delta dispersant use pre-approval area includes all waters seaward of the 3-mile state waters line (shown in red), shoreward of the 200-mile line (shown in green) and outside the Gulf of the Farallones, Cordell Banks, and Monterey Bay National Marine Sanctuaries (shown in magenta). Areas inside state waters or a National Marine Sanctuary are "RRT Approval Required"; RRT approval will be case-specific.

The offshore regions of the area are some of the most productive along the entire west coast. At least 11 species of sea birds are known to breed in the area including common murres, two species of auklets, storm petrels, tufted puffins, pigeon guillemots, and two species of cormorants. In addition, an additional 35 species of sea birds are seasonal visitors to the region (USGS, 2000). Several species of birds occur inshore, including the endangered marbled murrelet.

Recent oil spills in the San Francisco region have demonstrated that both common murres and marbled murrelets are very susceptible to spilled oil. Shore birds, including the endangered western snowy plover, are also at risk should spilled oil reach the shore.

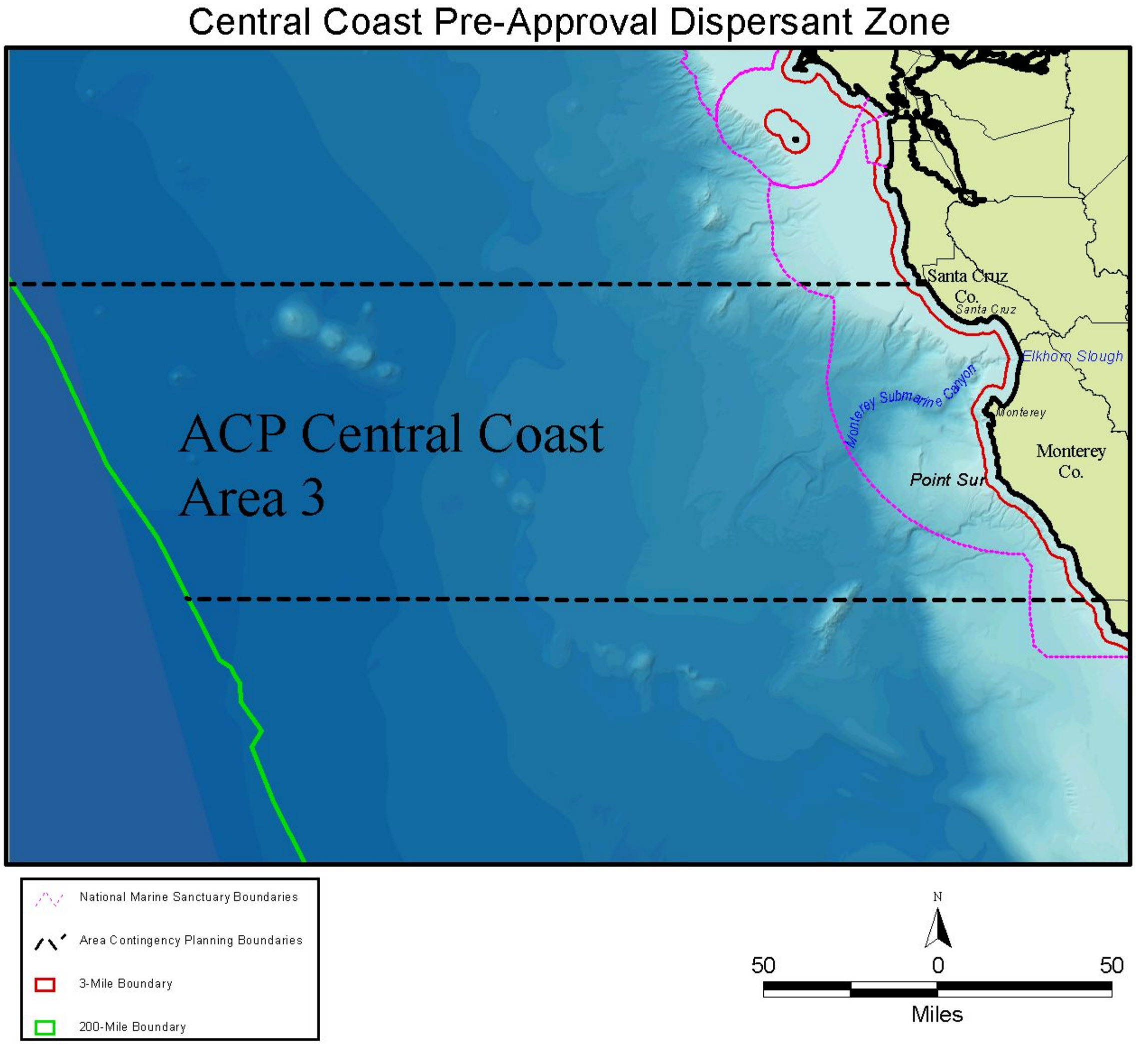
The offshore area is also a haven for marine mammals. At least 33 species of marine mammals have been reported for the region, many of which are federally listed as endangered or threatened. Endangered species include the blue, humpback, fin, sei, right and sperm whales; threatened species include the Stellar sea lion, Guadalupe fur seal and the California sea otter.

Most of the marine mammals are potentially at risk from spilled oil. In addition, heavy oiling of the intertidal and upland areas of the coast and Farallon Islands will threaten harbor seal, Stellar sea lion, northern elephant seal and northern fur seal pups.

The most sensitive regions of the waters off the San Francisco Area are the highly productive upwelling zones and shelf areas where both sea birds and marine mammals congregate in the spring and summer months to feed. These regions include Bodega Canyon, Cordell Banks, the region between Point Reyes and the Farallon Islands, and the shelf break off the most northern of the Farallon Islands.

As oil comes to shore, the rocky intertidal habitat, as well as wetlands and mud flats adjacent to river mouths, are at significant risk not only from the beached oil, but also from most of the cleanup procedures used to remove the oil. Of special concern in the marsh/wetland are many species of birds and mammals that inhabit these areas, as well as the potential for impacts to the young-of-the-year of the endangered Coho salmon and steelhead trout that may be residing in the area.

B.3 Central Coast



The Central Coast dispersant use pre-approval area includes all waters seaward of the 3-mile state waters line (shown in red), shoreward of the 200-mile line (shown in green) and outside the Monterey Bay National Marine Sanctuary (shown in magenta). Areas inside state waters or National Marine Sanctuaries are "RRT Approval Required"; RRT approval will be case-specific.

Oil spills within the offshore region of the Central Coast initially threaten all sea birds and marine mammals that frequent the area. If the spilled oil is driven on shore by the sea conditions and prevailing winds, additional resources (*e.g.*, shore birds, intertidal organisms, seal and sea lion pups) are at risk for oiling.

Seabirds off California are generally most abundant in nearshore waters over the continental shelf; abundance drops off dramatically over the continental slope and deep offshore waters. High concentrations of seabirds occur in nearshore waters off Santa Cruz and Monterey counties, although seabird abundance drops south of Pt. Sur due to low water column productivity. Sea birds seasonally tend to concentrate near upwelling zones, in and “down stream” of offshore current jets associated with headlands, along temperature and salinity gradients, and along the shelf break. Both seabirds and marine mammals concentrate in these regions due to the high abundance of food.

Sea bird densities are typically highest during the late summer through fall and winter periods (July through January) and lowest in April to June when birds are concentrated on their colonies. In general, sea bird densities decrease when moving from the inshore to the offshore environment, dropping off considerably seaward of the continental shelf break.

Over 100 species of sea birds have been reported from the region; about 70 of these species occur regularly. In the offshore (water depth > 200m) waters, common sea bird species occurring seasonally include sooty shearwaters, phalaropes, Leach’s storm petrel, northern fulmars, black-legged kittiwake, herring, Bonaparte’s, western and California gulls, Cassin’s and rhinoceros auklets, and common murres. In Monterey Bay proper, a significant segment of the world’s ashy storm-petrel population is present during the autumn. Near shore (water depth <200m), common species include sooty shearwaters, phalaropes, common murres, loons, western grebes, and western, California and Bonaparte’s gulls. In addition, endangered species including brown pelicans, marbled murrelets (northern area of region), western snowy plovers, and least terns occur seasonally in the nearshore area and would be at risk from oil entering this area.

Of all the sea birds occurring in the region, the common murre appears to be one of the species most frequently involved in oil spills. Data collected by the Office of Oil Spill Prevention and Response indicate that common murres are the most frequently oiled bird collected during recent central and northern California spill responses (Monterey Bay Mystery Oil Spill, 1997; Pt. Reyes tar ball incidents, 1997-98; T/V *Command* spill, 1999; San Mateo Mystery Spill (*Jacob Luckenbach*), 2001-03).

Shorebirds are another important component of the avifauna of the Central Coast area. More than 40 shorebird species have been recorded in central California; however, many of these are extremely rare, and only about 24 species occur regularly in the area. Although the majority of shorebirds occupy coastal wetlands, including estuaries, lagoons, and salt and freshwater marshes, they also occupy other coastal habitats, including sandy beaches and rocky shores. Common shorebird species in the area include black-bellied plover, willet, whimbrel, marbled godwit, black turnstone, sanderling, western sandpiper, least sandpiper, dunlin and dowitchers. Breeding shorebirds are limited to black oystercatcher, black-necked stilt, American avocet, killdeer, and the threatened western snowy plover, which nests and winters on sandy beaches.

Because of their migratory nature and the fact that few breed in the area, shorebirds are most abundant from fall through spring; comparatively few shorebirds remain during the summer months

A number of marine mammal species are potentially at risk from spilled oil in this region of the coast. At least 34 species of marine mammals inhabit or visit California waters. These include six species of pinnipeds (seals and sea lions), 27 species of cetaceans (whales, porpoises and dolphins) and the sea otter. Cetaceans, including a number of endangered species (blue, humpback, fin, sei, right and sperm whales), use area waters as year-round habitat and calving grounds, important seasonal foraging grounds or annual migration pathways. Neither of the two threatened or endangered pinniped species occasionally seen in the area (Guadalupe fur seal, Stellar sea lion) breed here, but a large breeding population of northern elephant seals occurs at Año Nuevo, directly to the north and adjacent to the Central Coast planning area. California sea lions, harbor seals and sea otters also occur here. Harbor seals breed on offshore rocks and isolated beaches of the central coast.   Aside from the breeding locations (Año Nuevo, the central coast) thousands of pinnipeds (elephant seals, California sea lions, harbor seals, Guadalupe fur seals, northern fur seals, Stellar sea lions) feed in and move through the area as either resident or migrating populations. The sea otter, a year-round resident of mainland central coast nearshore waters (generally within 6 miles of shore), is an endemic population of limited range and numbers currently experiencing population stress.

Marine mammals vary in their susceptibility to the effects of oiling. Since oil can destroy the insulating qualities of hair or fur, resulting in hypothermia, marine mammals that depend on hair or fur for insulation against the cold are among the most sensitive marine mammals to the effects of oil contamination. Most vulnerable to the direct effects of oiling among the pinnipeds are fur seals and newborn pups, which lack a thick insulating layer of fat. Cetaceans, which rely on layers of body fat and vascular control rather than pelage to retain body heat, are considered less vulnerable to the effects of oiling than pinnipeds.

Sea otters would be at high risk from an oil spill if oil were to reach nearshore waters of the region where most of the population is concentrated. Depending on the time of year, heavy oiling of intertidal and upland areas of the mainland coast could also threaten harbor seal and northern elephant seal pups.

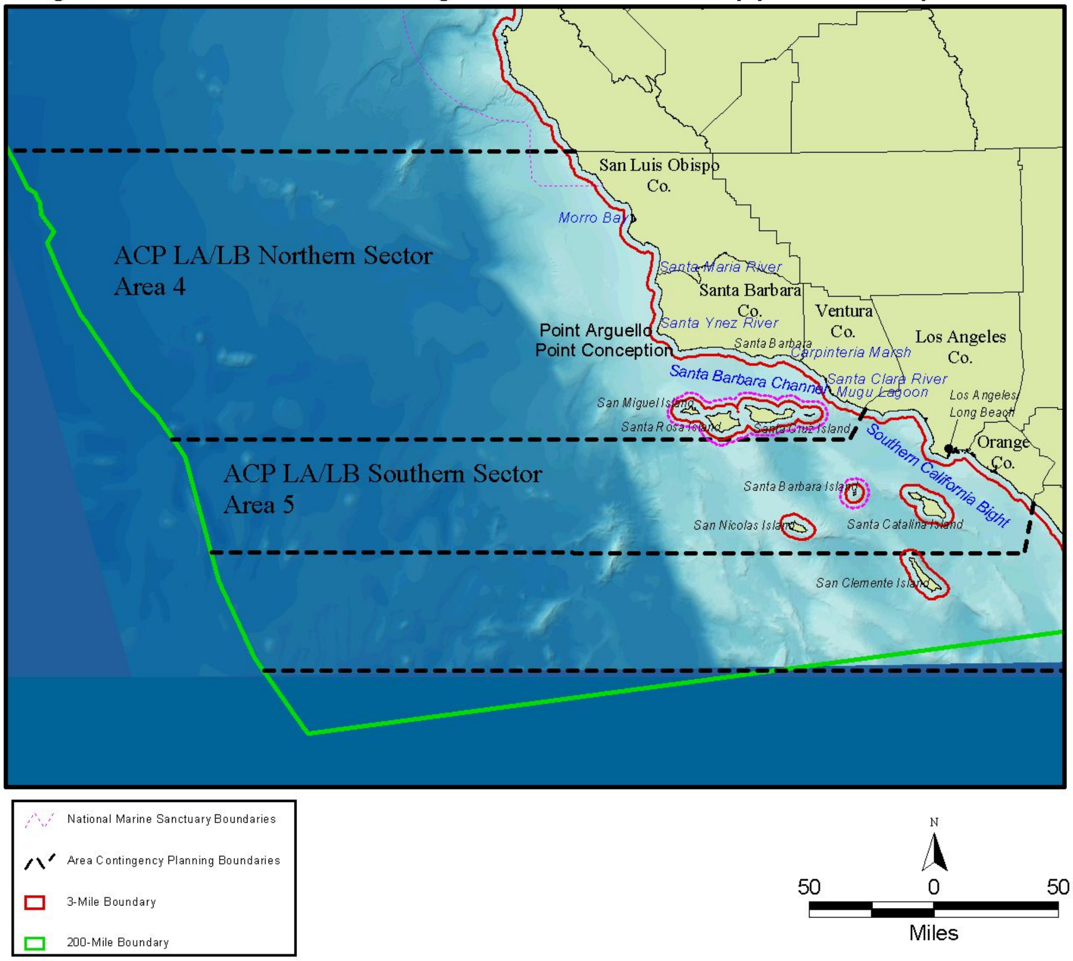
At least 554 species of California marine fishes inhabit or visit California waters. The high species richness is probably due to the complex topography, convergence of several water masses and changeable environmental conditions. The Monterey Submarine Canyon is an extremely important topographical feature in the central coast region, to which the area's large faunal species diversity and density is attributed. The fish represent a mix of permanent residents and periodic visitors. The important fish species of central California include northern anchovy, albacore tuna, jack mackerel, Pacific mackerel, Pacific bonito, Pacific sardine, Pacific whiting, Pacific herring, salmon, steelhead trout and sharks. Most of these species are widely distributed in the area, and it is unlikely that an oil spill will harm enough individuals, their prey or habitat to significantly decrease these populations. However, northern anchovy are of concern since their restricted distributions during parts of their life cycle make them vulnerable to impacts from spilled oil. Another species that is abundant in the epipelagic zone and vulnerable to impacts is the market squid. Although squid are widely distributed offshore during most of their life cycle, they congregate inshore in very large numbers during spawning. Monterey Bay is one of the most important spawning areas in the state.

Both rocky and sandy shallow habitats are at risk from spilled oil when it comes ashore. Various species of abalone are, where they occur, especially at-risk members of the shallow rocky habitat. Currently, all major species of abalone in the central California area are severely depleted. Their depleted condition and life histories make abalone in shallow habitats especially vulnerable (at the population level) to impacts from spilled oil.

As oil comes on shore, the rocky intertidal habitat as well as coastal wetlands and mud flats adjacent to river mouths are at significant risk both from the beached oil and from most of the cleanup procedures used to remove the oil. Of special concern in the coastal marsh/wetland areas is the potential for oiling many species of resident or visiting birds, mammals, young-of-the-year endangered Coho salmon, and steelhead trout.

B.4 Los Angeles (north and south)

Los Angeles-North and Los Angeles-South Pre-Approval Dispersant Zone



The Los Angeles (north and south) dispersant use pre-approval area includes all waters seaward of the 3-mile state waters line (shown in red), shoreward of the 200-mile line (shown in green) and outside the Channel Islands National Marine Sanctuary (shown in magenta). Areas inside state waters or National Marine Sanctuaries are "RRT Approval Required"; RRT approval will be case-specific.

Seabirds off California are generally most abundant in nearshore waters over the continental shelf; abundance drops off dramatically over the continental slope and deep offshore waters. High concentrations of seabirds occur in nearshore waters from Morro Bay to Point Arguello and the Santa Barbara Channel. Sea birds seasonally tend to concentrate near upwelling zones, in and "down stream" of offshore current jets associated with headlands, along temperature and salinity gradients, and along the shelf break. Both seabirds and marine mammals concentrate in these regions due to the high abundance of food.

Seabird densities are typically highest during the late summer through fall and winter periods (July through January) and lowest in April to June when birds are concentrated on their colonies. In general, seabird densities decrease when moving from the inshore to the offshore environment, dropping off considerably seaward of the continental shelf break.

Although over 100 species of seabirds have been reported from the region, the majority of individuals are composed of about 30 species. In the offshore waters (water depth > 200m), common seabird species occurring seasonally include sooty shearwaters, phalaropes, Leach's storm petrel, northern fulmar, black-legged kittiwake, gulls (herring, Bonaparte's, western and California), auklets (Cassin's and rhinoceros) and common murres. Nearshore (water depth <200m), common species include sooty shearwaters, phalaropes, common murres, loons, western grebes and western, California and Bonaparte's gulls. In addition, endangered species including brown pelicans, marbled murrelets (northern area of region), western snowy plovers, and least terns occur seasonally in the nearshore area and would be at risk from oil entering this area.

Breeding seabirds are especially vulnerable to oil spills. Seabird colonies occur on the Channel Islands and along the mainland from Pt. Conception north; few, if any, seabirds nest on the mainland south of Pt. Conception. The most common breeding species in this area include storm petrels (Leach's, ashy, and black), California brown pelican, cormorants (Brandt's, double-crested, and pelagic), western gulls and alcids (pigeon guillemot, Cassin's auklet, rhinoceros auklet). Although breeding seasons also vary from species to species, one or more species is generally conducting some aspect of reproduction (nest building, egg laying, chick rearing, etc.) from April through August. In 1989-1991, the total breeding seabird population of the project area was estimated at over 100,000 birds, representing about 16 percent of the total California seabird population.

Shorebirds are another important component of the avifauna of the Los Angeles-Long Beach area. More than 40 shorebird species have been recorded in central and southern California; however, many of these are extremely rare, and only about 24 species occur regularly in the area. Almost all shorebirds migrate to the area from northern breeding sites; very few shorebirds breed in this area. Although the majority of shorebirds occupy coastal wetlands, including estuaries, lagoons, and salt and freshwater marshes, they also occupy other coastal habitats, including sandy beaches and rocky shores. Common shorebird species in the area include black-bellied plover, willet, whimbrel, marbled godwit, black turnstone, sanderling, western sandpiper, least sandpiper, dunlin, and dowitchers. Breeding shorebirds are limited to black oystercatcher, black-necked stilt, American avocet, killdeer, and the threatened western snowy plover, which nests and winters on sandy beaches.

Because of their migratory nature and the fact that few breed in the area, shorebirds are most abundant from fall through spring; comparatively few shorebirds remain during the summer months. Important shorebird use areas include Mugu Lagoon, Santa Clara River mouth, Carpinteria Marsh, Goleta Slough, the Santa Ynez River mouth, and the Santa Maria River mouth. Shorebird densities are not available for these areas, but they are generally considered to be lower than heavily used areas, such as the San Francisco Bay. Although densities are not available, shorebirds occupying sandy beaches in nearby Ventura County averaged about 44 birds per linear kilometer of beach.

A number of marine mammal species are potentially at risk from spilled oil in this region of the coast. At least 34 species of marine mammals inhabit or visit California waters. These include six species of pinnipeds (seals and sea lions), 27 species of cetaceans (whales, porpoises, and dolphins), and the sea otter. Pinnipeds breed on the Channel Islands and on offshore rocks and isolated beaches along the mainland coast; thousands also move through the area during their annual migrations. Cetaceans, including a number of endangered species, use area waters as year-round habitat and calving grounds, important seasonal foraging grounds, or annual migration pathways. The sea otter, a year-round resident of the mainland coast north of Point Conception, is appearing in increasing numbers in the western Santa Barbara Channel and around the northern Channel Islands.

The threatened or endangered marine mammal species found in southern California waters include six whales (blue, humpback, fin, sei, right, and sperm whales), two pinnipeds (Guadalupe fur seal and Steller sea lion), and the southern sea otter. The two threatened pinniped species do not breed in the area and presently are uncommon in southern California waters.

Marine mammals vary in their susceptibility to the effects of oiling. Since oil can destroy the insulating qualities of hair or fur, resulting in hypothermia, marine mammals that depend on hair or fur for insulation are most likely to suffer mortality from exposure. Sea otters, which rely almost entirely on maintaining a layer of warm, dry air in their dense underfur as insulation against the cold, are among the most sensitive marine mammals to the effects of oil contamination. Most vulnerable to the direct effects of oiling among the pinnipeds are fur seals and newborn pups, which lack a thick insulating layer of fat. Cetaceans, which rely on layers of body fat and vascular control rather than pelage to retain body heat, are considered less vulnerable to the effects of oiling than pinnipeds.

Sea otters would be at high risk from an oil spill if oil were to reach nearshore waters of the region. Depending on the time of year, heavy oiling of intertidal and upland areas of the mainland coast could also threaten harbor seal and northern elephant seal pups. Similar contact to the northern Channel Islands, particularly San Miguel Island, could have significant impacts on California sea lion, northern fur seal, northern elephant seal, and harbor seal pups, and possibly on adult fur seals as well.

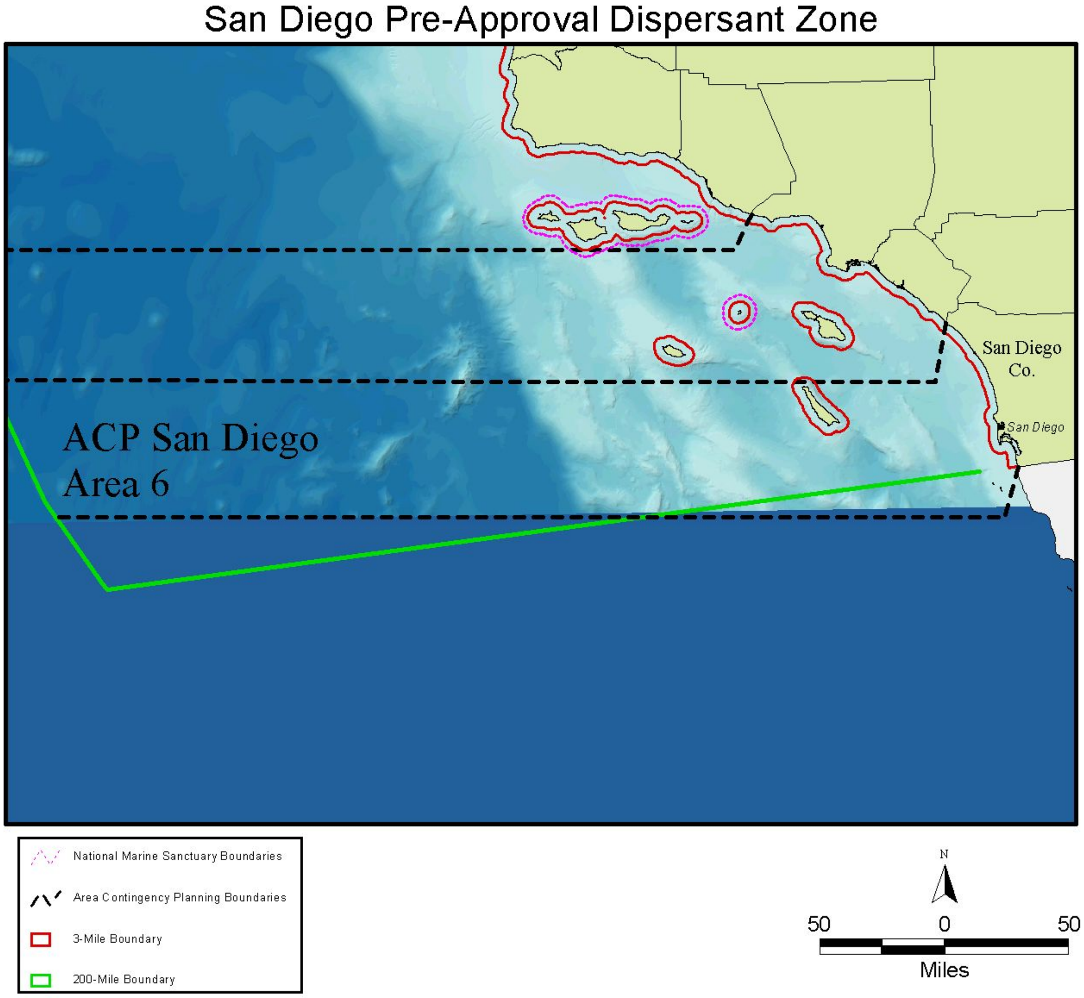
At least 554 species of California marine fishes inhabit or visit California waters. The high species richness is probably due to the complex topography, convergence of several water masses, and changeable environmental conditions. Point Conception is widely recognized as a faunal boundary with mostly cold-water species found to the north and warm-water species found to the south, though extensive migrations do occur as a result of fluctuating environmental conditions. In fact, warm- and cool-water events in the Southern California Bight (SCB) affect fish recruitment and can alter the composition of some fish assemblages for years. The SCB is located in the transition area between Pacific subarctic, Pacific equatorial, and North Pacific central water masses, and the fish fauna contains representatives from each of these sources. Of the 554 species of California marine fishes, 481 species occur in the SCB.

The pelagic realm is the largest habitat in the SCB and the home of 40 percent of the species and 50 percent of the families of fish. The pelagic zone includes the water column covering the shelf and the upper 150 to 200 m of water overlying the slope and deep basins. The fish from this zone represent a mix of permanent residents and periodic visitors. The important pelagic species of southern and central California include northern anchovy, albacore tuna, jack mackerel, Pacific mackerel, Pacific bonito, Pacific sardines, Pacific whiting, Pacific herring, salmon, steelhead trout, swordfish, and thresher shark. Most of these species are widely distributed in the SCB, and it is unlikely that an oil spill will harm enough individuals, their prey, or habitat to significantly decrease the population of a given species. However, northern anchovy are of concern since their restricted distribution during parts of their life cycle make them vulnerable to impacts from spilled oil. Another species that is abundant in the epipelagic zone and is vulnerable to impact is the market squid. Although during most of their life cycle squid are widely distributed offshore, squid congregate inshore in very large numbers during spawning. Monterey Bay and the northern Channel Islands are the most important spawning areas, but large spawning aggregations are known to occur along the entire coast from San Diego to Monterey.

Both rocky and sandy shallow habitats are at risk from spilled oil when it comes ashore. Abalone are an especially at-risk gastropod species of the shallow rocky habitat. Currently, all major species of abalone in central and southern California are severely depleted. Their depleted condition and life histories make abalone in shallow habitats especially vulnerable (at the population level) to impacts from spilled oil.

As oil comes on shore, the rocky intertidal habitat, as well as coastal wetlands and mud flats adjacent to river mouths are at significant risk both from the beached oil and from most of the cleanup procedures used to remove the oil. Of special concern in the coastal marsh/wetland areas is the potential for oiling many species of resident or visiting birds, mammals, young-of-the-year endangered Coho salmon, and steelhead trout.

B.5 San Diego



The San Diego dispersant use pre-approval area includes all waters seaward of the 3-mile state waters line (shown in red), and shoreward of the 200-mile line (shown in green). Areas inside state waters or within 3 miles of the California-Mexico border are "RRT Approval Required"; RRT approval will be case-specific.

Oil spills within the offshore region initially threaten all seabirds and marine mammals that frequent the area. If the spilled oil is driven on shore by the sea conditions and prevailing winds, additional resources (*e.g*., shorebirds, intertidal organisms, seal and sea lion pups) and their shoreline haulout, roosting, and nesting habitats are also at risk for oiling.

Seabirds off California are generally most abundant in nearshore waters over the continental shelf; abundance drops off dramatically over the continental slope and deep offshore waters. Sea birds seasonally tend to concentrate near upwelling zones, in and "down stream" of offshore current jets associated with headlands, along temperature and salinity gradients, and along the shelf break. Both seabirds and marine mammals concentrate in these regions due to the high abundance of food.

Seabird densities are typically highest during the late summer through fall and winter periods (July through January) and lowest in April to June when birds are concentrated on their colonies. In general, seabird densities decrease when moving from the inshore to the offshore environment, dropping off considerably seaward of the continental shelf break.

Although over 100 species of seabirds have been reported from the region, the majority of individuals are composed of about 30 species. In the offshore (water depth > 200m) waters, common seabird species occurring seasonally include sooty shearwaters, phalaropes, Leach's storm petrel, northern fulmar, black-legged kittiwake, gulls (herring, Bonaparte's, western and California), auklets (Cassin's and rhinoceros) and common murres. Nearshore (water depth <200m), common species include sooty shearwaters, phalaropes, common murres, loons, western grebes and western, California and Bonaparte's gulls. In addition, endangered species including the brown pelicans, marbled murrelets (northern area of region), western snowy plovers, and least terns occur seasonally in the nearshore area and would be at risk from oil entering this area.

Shorebirds are another important component of the avifauna of the San Diego area. More than 40 shorebird species have been recorded in central and southern California; however, many of these are extremely rare, and only about 24 species occur regularly in the area. Almost all shorebirds migrate to the project area from northern breeding sites; very few shorebirds breed in this area. Although the majority of shorebirds occupy coastal wetlands, including estuaries, lagoons, and salt and freshwater marshes, they also occupy other coastal habitats, including sandy beaches and rocky shores.

A number of marine mammal species are potentially at risk from spilled oil in this region of the coast. At least 34 species of marine mammals inhabit or visit California waters. These include six species of pinnipeds (seals and sea lions) and 27 species of cetaceans (whales, porpoises, and dolphins). Cetaceans, including a number of endangered species, use area waters as year-round habitat and calving grounds, important seasonal foraging grounds, or annual migration pathways.

The threatened or endangered marine mammal species found in southern California waters include six whales (blue, humpback, fin, sei, right, and sperm whales) and two pinnipeds (Guadalupe fur seal and Steller sea lion). The two threatened pinniped species do not breed in the area and presently are uncommon in southern California waters.

Marine mammals vary in their susceptibility to the effects of oiling. Since oil can destroy the insulating qualities of hair or fur, resulting in hypothermia, marine mammals that depend on hair or fur for insulation are most likely to suffer mortality from exposure. Most vulnerable to the direct effects of oiling among the pinnipeds are fur seals and newborn pups, which lack a thick insulating layer of fat. Cetaceans, which rely on layers of body fat and vascular control rather than pelage to retain body heat, are considered to be less vulnerable to the effects of oiling than pinnipeds.

At least 554 species of California marine fishes inhabit or visit California waters. The high species richness is probably due to the complex topography, convergence of several water masses, and changeable environmental conditions. Point Conception is widely recognized as a faunal boundary with mostly cold-water species found to the north and warm-water species found to the south, though extensive migrations do occur as a result of fluctuating environmental conditions. In fact, warm- and cool-water events in the Southern California Bight (SCB) affect fish recruitment and can alter the composition of some fish assemblages for years. The SCB is located in the transition area between Pacific subarctic, Pacific equatorial, and North Pacific central water masses, and the fish fauna contains representatives from each of these sources. Of the 554 species of California marine fishes, 481 species occur in the SCB.

The pelagic realm is the largest habitat in the SCB and the home of 40 percent of the species and 50 percent of the families of fish. The pelagic zone includes the water column covering the shelf and the upper 150 to 200 m of water overlying the slope and deep basins. The fish from this zone represent a mix of permanent residents and periodic visitors. The important pelagic fish species of southern and central California include northern anchovy, albacore tuna, jack mackerel, Pacific mackerel, Pacific bonito, Pacific sardines, Pacific whiting, Pacific herring, salmon, steelhead trout, swordfish, and thresher shark. Most of these species are widely distributed in the SCB, and it is unlikely that an oil spill will harm enough individuals, their prey, or habitat to significantly decrease the population size of any given species. However, northern anchovy are of concern since their restricted distributions during parts of their life cycle make them vulnerable to impacts from spilled oil. Another species that is abundant in the epipelagic zone and is vulnerable to impacts is the market squid. Although during most of their life cycle squid are widely distributed offshore, squid congregate inshore in very large numbers during spawning. Monterey Bay and the northern Channel Islands are the most important spawning areas, but large spawning aggregations are known to occur along the entire coast from San Diego to Monterey.

Both rocky and sandy shallow habitats are at risk from spilled oil when it comes ashore. Abalone are an especially at-risk gastropod species of the shallow rocky habitat. Currently, all major species of abalone in central and southern California are severely depleted. Their depleted condition and life histories make abalone in shallow habitats especially vulnerable (at the population level) to impacts from spilled oil.

As oil comes on shore, the rocky intertidal habitat, as well as coastal wetlands and mud flats adjacent to river mouths are at significant risk both from the beached oil and from most of the cleanup procedures used to remove the oil. Of special concern in the coastal marsh/wetland areas is the potential for oiling many species of resident or visiting birds, mammals, young-of-the-year endangered Coho salmon, and steelhead trout.

APPENDIX C

DISPERSANT EFFICACY AND AVAILABLE RESOURCES

C.1 Oils produced from California offshore platforms

Oil Field Name	Platform Name	Pacific Outer Continental Shelf Study	Minerals Management Service/EC Catalog	
		API Gravity	Name	API Gravity
Beta	Ellen Elly Eureka Edith	17.3 – 18.3	Beta	13.7
Carpinteria	Hogan Houchin Henry	24.2	Carpinteria	22.9
Dos Cuadras	Hillhouse A B C	24.3	Dos Cuadras	25.6
Hondo	Hondo Harmony	21.5	Hondo	19.6
Hueneme	Gina	20.9	Port Hueneme	
Pescado	Heritage	21.5		
Pitas Point	Habitat		Pitas Point	38
Point Arguello	Hidalgo Harvest Hermosa	22.2	Point Arguello Commingled Point Arguello Heavy Point Arguello Light	21.4 18.2 30.3
Point Pedernales	Irene	21.1	Platform Irene	11.2
Sacate				
Santa Clara	Gilda Grace	20.9	Santa Clara	22.1
Sockeye	Gail	21.6	Sockeye Sockeye Commingled Sockeye Sour Sockeye Sweet	26.2 19.8 18.8 29.4
			Platform Holly	11

From S.L. Ross, 2002

C.2 Some fresh oil properties of top ten oils shipped to California by tank ship, 1999-2001

	Identifying Properties			
Oil Type	API gravity	Sulfur content (%)	Viscosity at 15º C, cP	Pour point, ºC
Alaska North Slope	26.8	1.15	17	-15
Arab Medium	30.8	2.4	29	-10
Maya	21.8	3.3	299	-20
Arabian Light	33.4	1.77	14	-53
Oriente	29.2	1.01	85	-4
Basrah Light	33.7	1.95	20	-15
Escalante/Canadon Seco	24.1	0.19	?	?
Arabian Extra Light	37.9	1.2	?	?
FAO Blend	31.0	3.0	?	?
Yemen	31.0	0.6	?	?

C.3 Pacific OCS and imported California oils that have undergone spill-related testing and modeling

Crude oil name	API gravity	Fresh oil pour point (ºC)	Oil viscosity @ 15 ºC at various weathered states			Emulsion formation tendency	Dispersant "Window of Opportunity"
HIGHLY EMULSIFIABLE OILS (Emulsion forms at 0 to 10% oil evaporation)							
Arab Medium	29.5	-10	29	91	275	Yes @ 0%	Very narrow
Arab Light	31.8	-53	14	33	94	Yes @ 0%	Narrow
Hondo	19.6	-15	735	9583	449700	Yes @ 0%	Very narrow
Hueneme	14.8	-9	4131	20990		Yes @ 0%	Very narrow
Maya	21.8	-20	299	99390		Yes @ 0%	Very narrow
Oriente	25.9	-4	85		6124	Yes @ 0%	Very narrow
Pt. Arguello Commingled	21.4	-12	533	41860	2266000	Yes @ 0%	Very narrow
Pt. Arguello Heavy	18.2	-4	3250		4953000	Yes @ 0%	Very narrow
Pt. Arguello Light	30.3	-22	22	183	671	Yes @ 0%	Very narrow
Santa Clara	22.1	-3	304	1859	22760	Yes @ 0%	Very narrow
Sockeye	26.2	-12	45	163	628	Yes @ 0%	Very narrow
Sockeye Sour	18.8	-22	821	8708	475200	Yes @ 0%	Very narrow
MEDIUM EMULSIFIABLE OILS (Emulsion forms at 11 to 29% oil evaporation)							
Alaska North slope	26.8	-15	17	110	650	Yes @ 26%	Narrow
Carpinteria	22.9	-21	164	3426		Yes @ 11%	Narrow
Dos Cuadras	25.6	-30	51	187	741	Yes @ 11%	Narrow
Sockeye Sweet	29.4	-20	20	39	321	Yes @ 17%	Narrow
OILS THAT DO NOT EMULSIFY							
Diesel	39.5	-30	8	25	100	No	Very wide
Pitas Point	38.0	<-60	2		2	No	Very wide

Crude oil name	Hours for oil to reach specified viscosity in 10 kt winds and 15ºC water temperature					
	(Modeled) 1000 barrel batch spill (*i.e.*, from tank ship)			(Modeled) 10,000 barrel batch spill (*i.e.*, from tank ship)		
	2000 cP	5000 cP	20,000 cP	2000 cP	5000 cP	20,000 cP
HIGHLY EMULSIFIABLE OILS (Emulsion forms at 0 to 10% oil evaporation)						
Arab Medium	4.2	6.4	22.0	4.9	7.7	39.0
Arab Light	10.0	36.0	Disp @ 41 hrs	13.3	68.8	Disp @ 68 hrs
Hondo	2.0	3.0	5.5	2.4	3.7	6.2
Hueneme	0.0	0.5	1.9	0.0	0.5	1.9
Maya	1.6	2.3	4.8	1.8	2.6	5.1
Oriente	2.2	3.2	5.2	2.8	3.8	6.4
Pt. Arguello Commingled	1.6	2.6	4.3	1.7	2.9	4.9
Pt. Arguello Heavy	0.0	0.5	1.7	0.0	0.5	1.9
Pt. Arguello Light	4.4	6.9	23.0	5.1	8.1	42.0
Santa Clara	2.6	3.8	6.6	2.9	4.4	7.9
Sockeye	3.9	5.6	13.2	4.3	6.4	20.4
Sockeye Sour	1.1	1.9	3.1	1.3	2.0	3.5
MEDIUM EMULSIFIABLE OILS (Emulsion forms at 11 to 29% oil evaporation)						
Alaska North slope	37.9	39.7	43.3	60.7	62.2	66.7
Carpinteria	5.6	6.6	8.9	8.3	9.5	12.0
Dos Cuadras	5.4	7.0	11.0	7.4	8.9	14.3
Sockeye Sweet	8.6	10.6	28.8	11.6	14.1	47.8
OILS THAT DO NOT EMULSIFY						
Diesel	60.0	Disp @ 69 hrs		101.0	Disp @ 111 hrs	
Pitas Point	Disp @ 2.3 hrs			Disp @ 3.5 hrs		

The opportunity for using dispersants effectively on most oils listed above is limited. Only a few of the produced oils appear amenable to dispersion. However, if spill circumstances are right and response is very rapid, some success might be possible. The situation is different for the imported oils. Alaska North Slope crude, which represents about 50% of the oil spill risk from tankers in California, appears to be quite amenable to dispersion. Diesel oil, which is ubiquitous and therefore tends to be spilled relatively frequently, is also a good candidate.

From S.L. Ross, 2002

C.4 Description of general oil characteristics based on oil type

Type	Description	Characteristics	Crude oil examples	Refined product examples
I	**Light distillates** No need to disperse; oil will dissipate rapidly**.**	Specific gravity: <0.80 API gravity: >45 Viscosity: 0.5-2.0 cSt @ 15º C Non-persistent, very volatile, highly flammable, high evaporation rates, rapid spreading rates, highly toxic to biota, little if any emulsification, high penetration of substrate.	Algerian blend	Maui and Kapuni distillate, gasoline blendstocks, motor spirit (RMS/PMS), Avgas, Jet A1, kerosene
II	**Light crudes** Relatively non-persistent. Easily dispersed if pour point under 41º F; probably difficult to disperse if water temperature is below pour point (behaves like a Group IV oil).	Specific gravity: 0.80-0.85 API gravity: 35-45 Viscosity: 4 cSt to solid @ 15º C Non-persistent, moderate to high volatility, low to moderate viscosity, moderate to high toxicity, can form stable emulsions, moderate to high penetration of substrates.	Pour point <41º F: Brent, Ekofisk, Forties, Murban, Seria Light Pour point >41º F: Ardjuna, Beatrice, Camar, Lucina, Palanca, Angola, Pennington	Unfinished oils; automotive gas oil, marine gas oil, Navy gas oil
III	**Medium – heavy crudes, fuel oils** Fairly persistent, easily dispersed if treated promptly.	Specific gravity: 0.80-0.95 API gravity: 17.5-35 Viscosity: 8 cSt to solid @ 15º C Persistent, moderate volatility, moderate viscosity, variable acute toxicity, can form stable emulsions, low to moderate penetration of substrates.	Pour point < 41º F: Alaskan, Arabian light, Basrah, Dubai, Iranian heavy, Kuwaiti, Maya, Oriente Pour point > 41º F: Bonny light, Coban blend, Gamba, LSWR, Minas, Santa Cruz, Taching, Zaire	
IV	**Heavy crudes and residues** Fairly persistent, probably difficult to disperse if water temperature is below pour point of material.	Specific gravity: 0.9501.00 API gravity: 10.0-17.5 Viscosity: 1500 cSt to solid @ 15º C Persistent, low to moderate volatility, moderate to high viscosity, variable acute toxicity, can form stable emulsions, low to moderate penetration of substrates.		Heavy fuel oil, residues, Fletcher blend, Maui F sands < pour point, lube oils, lube oil blendstocks
V	**Non-spreading oils** Persistent, generally not dispersible	Specific gravity: >1.00 API gravity: <10.0 Viscosity: Solid unless heated Persistent, very low volatility, little if any evaporation, very high viscosity, very low acute toxicity, can form stable emulsions, little if any penetration of substrate.		Heavy bunker fuel oil, bitumen, very heavy fuel oil, asphalt, paraffins, waxes, residual fuels

In part from Cawthron, 2000

C.5 General California dispersant application platform information

Application method	Weather limitations	Advantages	Disadvantages
C-130/ADDS Pack	Winds: 30 – 35 kts Waves: 17 – 23 ft	Suitable for very large spills with longer (several day) time windows to accommodate the minimum 24-hour startup time. Greatest delivery capacity; might be capable of fully treating all of the oil spilled in a blowout spill and all oil in a 10,000 bbl batch spill.	At present the nearest ADDS Pack units are outside the state; start-up times may be lengthy; spraying not likely to begin until the second day of the spill; very expensive; requires runway.
DC-4		Suitable for very large spills with longer (several day) time windows to accommodate the minimum 24-hour startup time. The platform modeled is owned by Airborne Support Incorporated of Houma, LA; delivery capacity is approximately one-half that of the C-130 ADDS Pack.	Earliest this aircraft can begin spraying dispersant in California is probably the morning of the second day.
Single-engine planes (*e.g.*, Cessna AT-802 "Agtruck")	Winds: 17 – 21 kts Waves: 6 – 9 ft Ceiling: ≥1000 ft Visibility: ≥ 3 nm	Suitable for small- to mid-sized spills that occur at considerable distance from the response centers provided the time window is long enough to accommodate their slower startup time. Purpose-built for aerial spraying; capable of fairly short start-up time; a number of Agtrucks available for use in a large spill; other small planes may be relatively inexpensive.	Smaller payload; more limited range; not yet available in California, although one AZ operator may be under contract to CA OSRO; platform may not be available until beginning of the second day; limited to smaller spills; uses neat dispersant only
Medium-size helicopter	Winds: 17 – 27 kts Waves: 6 – 17 feet	Available; highly maneuverable; capable of being re-supplied near spill site; good operational efficiency; lands almost anywhere. Above sea blowouts from oil platforms (of oils with a <u>medium</u> emulsification rate) are good candidates for treatment by ship and helicopter platforms because they can remain on-scene and deliver dispersants constantly when needed. May be adequate to deal with small tanker spills close to their re-supply bases; could also respond to mid-sized spills provided the time window is long enough.	Limited by small payload and range; two are available in southern CA; use neat dispersant only. Blowouts of high emulsification rate oils will <u>not</u> be good candidates for dispersion from any platform type. Ship-based delivery may be limited by slow transit speed and small payload. These platforms are limited for spills at a distance from their base of operations, either because of slow transit speed or limited operating range. These limitations can be overcome in some circumstances by re-supplying them at or near the spill site.
Work boat	Winds: 7 – 21 kts Waves: 1 – 9 feet	Good control; mixes water. Above-sea blowouts from oil platforms (of oils with a <u>medium</u> emulsification rate) are good candidates for treatment by ship and helicopter platforms because they can remain on-scene and deliver dispersants constantly when needed. May be adequate to deal with small tanker spills close to their re-supply bases; could also respond to mid-sized spills provided the time window is long enough.	Moderate transit speed; only two ship-based systems (high-speed crew-cargo vessels) available in CA; limited to small spills; limited swath width. Blowouts of high emulsification rate oils will <u>not</u> be good candidates for dispersion from any platform type. Ship-based delivery may be limited by slow transit speed and small payload. These platforms are limited for spills at a distance from their base of operations, either because of slow transit speed or limited operating range. These limitations can be overcome in some circumstances by re-supplying them at or near the spill site.

From S.L. Ross, 2002

C.6 Characteristics of dispersant spraying platforms available to operators in California

Application system	Payload (gallons)	Pump rate (gpm)	Swath width (feet)	Average transit speed (knots)	Average				
					Start-up time (hours)	Spray speed (knots)	Repositioning time (minutes)	Resupply time (hours)	Range
C-130/ADDS-pack	5500	600	100	214	24	140	2	1	7 hours
DC-4 [a]	2000-2500	500	100	214	1	157	2	1	
Agtruck AT-802	800	120	80	200	4	140	0.5	1	200 miles
Agtruck AT-502	500	120	80	200	4	140	0.5	1	200 miles
Helicopter	150	79	80	90	1	50	0.5	0.25	1.75 miles
Vessel A [b]	1000	10	120	7	1	7	2	1	
Vessel D [c]	20,000	60	175	25	1	25	2	1	

[a] Values reported in the literature for aircraft logistic characteristics such as payload are somewhat variable. For the DC-4 payload, values range from 2000 to 2500 gallons. The value used in calculations is at the upper end of this range, 2500 gallons. It must be recognized that the payload of the existing DC-4 platform in the Gulf of Mexico area is somewhat lower than this at 2000 gallons.

[b] Modeled after Clean Seas boom type vessel spray system.

[c] Modeled after new portable single-nozzle spray system developed by National Response Corporation (NRC) and mounted on one of NRC's crew-cargo vessels. System characteristics are as follows:

- Payload: capacity is up to 20,000 gallons in the form of up to 10 2000-gallon DOT marine-portable tanks
- Pump rates: variable at 12, 25, 40 and 60 gallons per minute
- Swath width: range of nozzle varies with pump rate up to 70 feet @ 60 gpm, with one system on each side. Allowing for the 35' beam of the vessel, swath width is 140'
- Vessel speed: maximum speed is 25 knots

From S.L. Ross, 2002

C.7 Dispersant spraying capacity of platforms as a function of distance [a]

Platform	Operating distance (miles)	Number of sorties per day	Payload (barrels)	Volume of dispersant sprayed per day (barrels)	Volume of oil dispersed per day (barrels) [b]
C-130/ADDS Pack [c]	10	4	130.8	523.2	10464
	30	4	130.8	523.2	10464
	100	3	130.8	39234	7848
	200	3	130.8	392.4	7848
DC-4 [d]	10	6	47.6	285.6	5712
	30	5	47.6	238.1	4761
	100	4	47.6	190.4	3808
	200	3	47.6	142.8	2856
AT-802	10	8	18.9	151.2	3024
	30	7	18.9	132.1	2642
	100	5	18.9	94.4	1887
	200	3	18.9	56.6	1132
Helicopter	1	30	5.7	169.8	3396
	10	21	5.7	119.7	2394
	30	11	5.7	62.3	1245
Vessel [e]	1	3	23.8	71.4	1428
	10	2	23.8	47.6	952
	30	1	23.8	23.8	476
	100	1	23.8	23.8	476

[a] Based on response to a batch spill of 3180 m^3 (20,000 barrels).
[b] Assuming 20 volumes of oil are dispersed per 1 volume of dispersant sprayed.
[c] ADDS Pack specifications as per Biegert Aviation: Maximum reservoir capacity = 5500 gallons (20.8 m^3 = 130.8), recommended capacity = 5500 gallons (18.9 m^3).
[d] Values reported in literature for payload of DC-4 range from 2000 to 2500 gallons (7.5 to 9.5 m^3); value used here is 2000 gallons (= 47.6 barrels) as per ASI, Houma, LA.
[e] Modeled after Clean Seas boom type vessel spray system.

From S.L. Ross, 2002

C.8 Stockpiles of dispersant application resources in California and North America

Organization	Equipment types	Type of dispersant	Dispersant storage location	Quantity of dispersant (gallons)
Within California [a]				
Clean Bay Cooperative [b] 2070 Commerce Avenue Concord, CA 94520 Contact: Steve Ricks Phone: 925-685-2800		Corexit 9527	Concord, CA	15,015
Clean Seas Cooperative [c] 1180 Eugenia Place, Suite 204 Carpinteria, CA 93013 24-hr phone: 805-684-3838 Contacts: Merrill Jacobs Phone: 805-684-4811 Jim Caesar Phone: 805-684-4392	<u>Boats</u> Mr. Clean & Mr. Clean III: 1000 gallons Corexit 9527 on board each vessel. Swath width for Mr. Clean is 105 ft, for Mr. Clean III is 115 ft; vessel calibration and dosage rate vary from speeds of 3 to 10 knots and dosage rates from 2 – 10 gal/acre. <u>Aerial (helicopter)</u> Storage 150 gal max; pumping rate 50 – 100 gal per minute; boom length 32 ft, swath 50 – 60 ft depending on speed; speed 50 – 100 kts; dosage rate 2, 3 or 5 gal per acre. <u>Yard Inventory (Corexit 9527)</u> (2) 5000 gal tankers = 10,000 (13) 550 gal tanks = 7150 (20) 55 gal barrels = 1100 (1) 500 gal tank = 500 Clean Seas also has 880 gals of shoreline dispersant (Corexit 7664) stored at yard.	Corexit 9527	Carpinteria, CA	20,750

C.8, continued Stockpiles of dispersants application resources in California and North America

Organization	Equipment types	Type of dispersant	Dispersant storage location	Quantity of dispersant (gallons)
Clean Coastal Waters [d] Clean Coastal Waters, Inc. 190 South Pico Avenue Long Beach, CA 90802-6247 Contacts: Ray Nottingham Phone: 562-432-1415 ext. 222 Dave Redmond Phone: 562-432-1415	Aerial Contract with Emergency Aerial Dispersant Consortium (EADC) for an Air Tractor 802 (crop duster type airplane). Arizona to Long Beach response time of 6 hours after notification. AT 502 on backup through EADC if needed. AT 802 holds approximately 800 gallons of dispersant. Can deploy full load of dispersant within approximately 15 minutes. CCW stores Corexit 9527 in their Long Beach yard in 350 gallon totes for easier storage and transport.	Corexit 9527		6,545
Other North American Dispersant Stockpiles [e]				
Alyeska Pipeline Service Company P.O. Box 196660 Anchorage, AK 99519-6660 Phone: 907-278-1611		Corexit 9527 Corexit 9527	Anchorage, AK Valdez, AK	56,000 4,000
Clean Islands Council/State of Hawaii 179 Sand Islands Access Road Honolulu, HI 96819 Phone: 808-845-8465		Corexit 9527 Corexit 9500	Honolulu, HI Honolulu, HI	3,080 34,180
Clean Caribbean Cooperative 2381 Stirling Road Fort Lauderdale, FL 33312 Phone: 954-983-9880		Corexit 9527 Corexit 9500	Pt. Everglades, FL Pt. Everglades, FL	4,070 25,300
LOOP, Inc. 1 Seine Court New Orleans, LA 70114 Phone: 504-368-5667		Corexit 9527	Houma, LA	33,600
Clean Gulf Associates 1450 Poydras Street, Suite 1625 New Orleans, LA 70112 Phone: 888-242-2007		Corexit 9527 Corexit 9500	Houma LA Sugarland, TX	5,665 28,985
Marine Spill Response Corporation 120 Fieldcrest Avenue Edison, NJ 08837 Phone: 732-417-0500		Corexit 9527	Lyndon, NJ	24,640
CISPRI (CIRO) 1392 Ocean Drive Homer, AK 99603 Phone: 907-235-6785		Corexit 9527 Corexit 9527	Niski, AK Anchorage, AK	9,295 11,275

C.8, continued Stockpiles of dispersants application resources in California and North America

Organization	Equipment types	Type of dispersant	Dispersant storage location	Quantity of dispersant (gallons)
Marine Spill Response Corporation **Clean Gulf Associates** 396 Roland Road Houma, LA 70363 Phone: 985-580-0924		Corexit 9527	Houma, LA	16,000
Airborne Support, Inc. 3626 Thunderbird Road Houma, LA 70363 Phone: 985-851-6391		Corexit 9527 Corexit 9500	Houma, LA Houma, LA	2,000 4,470
National Response Corporation 11200 Westheimer Road Houston, TX 77042 Phone: 713-977-9951 Houston, TX		Corexit 9527 Corexit 9500	Cameron, LA Morgan City, LA	1,540 220
Clean Sound Cooperative 1105 13th Street Everett, WA 98201 Phone: 425-783-0908		Corexit 9527	Blaine, WA	6,270
Delaware Bay & River Cooperative 700 Pilottown Road Lewes, DE 19958 Phone: 302-645-7861		Corexit 9527	Slaughter Beach, DE	1,650
Clean Harbors Cooperative 4601 Tremley Point Road Linden, NJ 07036 Phone: 908-862-7500		Corexit 9527	Lyndon, NJ	1,375
Nalco Exxon Energy Chemicals Hwy 42 North Kilgore, TX 75662 Phone: 903-984-1695		Corexit 9527 Corexit 9500	Sugarland, TX Sugarland, TX	Producer

[a] The amount of dispersant currently (2003) available in California is 42,310 gallons (1007 barrels), sufficient to treat 20,140 barrels of oil, assuming a 1:20 (dispersant:water) dilution ratio.
[b] Email communication, Steve Ricks (Clean Bay) to Ellen Faurot-Daniels (California Coastal Commission), 12/12/03.
[c] Email communication, Jim Caesar (Clean Seas) to Ellen Faurot-Daniels (California Coastal Commission), 11/25/03.
[d] mail communication, Ray Nottingham (Clean Coastal Waters) to Ellen Faurot-Daniels (California Coastal Commission), 12/02/03.
[e] Substantively from S.L. Ross, 2002. North American stockpile values are approximate because quantities change constantly. A portion of the 273,615 gallons (6514 bbls) could be made available for use on spills in California. Assuming a 1:20 dilution ratio, this quantity is sufficient for a spill of approximately 150,000 barrels.

Updated from Cawthron, 2000

C.9 Manufacturers of dispersant spray systems for boats, helicopters and fixed-wing aircraft

Dispersant spray equipment for boats, helicopters and fixed-wing aircraft are available from various manufacturers throughout the world. Table C.9 is a partial representative listing. Publications such as the *International Oil Spill Control Directory* and the *World Catalog of Oil Spill Response Products* have more complete listings that are periodically updated.

Dispersant application systems differ in design, capability, versatility, size, weight, ease of handling and control of dosage. Their suitability depends in part on the type of dispersant used. Concentrated dispersants such as Corexit 9500 and Corexit 9527 are generally most appropriate for modern spray equipment. A detailed description of application equipment requirements is presented in the 1997/1998 *World Catalog of Oil Spill Response Products*.

	Boats	Helicopters	Fixed-wing aircraft
ABASCO 363 West Canino Houston, Texas 77037 Phone: 800-242-7745	X	X	X
Ayles Fernie International, Ltd. Unit D5 Chaucer Business Park Kemsing, Seven Oaks, Kent TN15 6YU England Phone: 44/1732762962	X		
Biegert Aviation, Inc. 22022 South Price Road Chandler, Arizona 85245 Phone: 602-796-2400			X
CECA S.A. (Subsidiary of Elf Aquitane Group) Avenue Alfred Nobel – 64000 PAU France Phone: 33/559 92 44 00	X		
Helitask Bourne Airfield Cambridge CB3 7TQ England Phone: 44/954-210-765		X	
KU-SINTEF Group S.P. Andersens vei 15b N-7034 Trondheim, Norway Phone: 47 73 59 11 00		X	
KOLDA Corporation 16770 Hedgecroft, Suite 708 Houston, Texas 77060 Phone: 281-448-8995	X		X

C.9, continued Manufacturers of dispersant spray systems for boats, helicopters and fixed-wing aircraft

	Boats	Helicopters	Fixed-wing aircraft
KAAF Agro Aviation Les Jasses D'Albaron 13123 Albaror Arles, France Phone: 33/9071188		X	
Kepner Plastic Fabricators, Inc. 3131 Lomita Blvd. Torrance, California 90505 Phone: 310-325-3162	X		
Ro-Clean Desmi 21B Hestehaven DK5260, Odense S. Denmark Phone 45-65-910-201	X		
Simplex Manufacturing Company 13340 NE Whitaker Way Portland, Oregon 97230 Phone: 503-257-3511		X	
Slickbar Products Corporation 18 Beach Street Seymour, Connecticut 06483 Phone: 203-888-7700	X		
Transland, Inc. 24511 Frampton Avenue Harbor City, California 90710 Phone: 310-534-2511	X		
Vikoma International Ltd. Prospect Road Cowes, Isle of Wight PO31 7AD, England		X	

From ExxonMobil, 2000

APPENDIX D

INSTRUCTIONS AND FORMS

D.1 Estimated dispersant dosages based on average oil thickness and dispersant-to-oil ratios

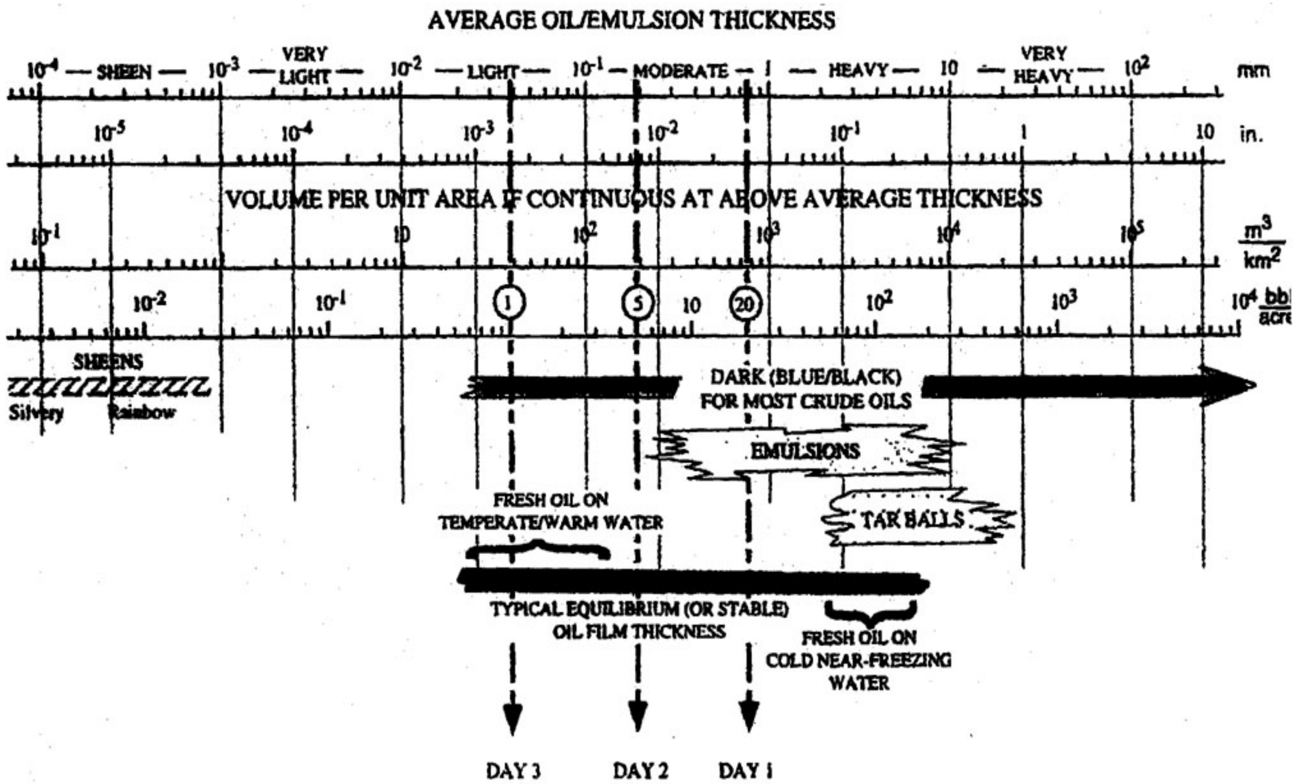
Average oil thickness (inches) (mm)	Relative thickness	Oil concentration (volume of oil/unit area)	Dispersant-to-oil ratio (DOR) 1:1*	1:5 *	1:10	1:20	1:50	1:100
.0004 in (0.01 mm)	Very light to light	Gallons/acre	10.7	2.14	1.1	0.5	0.2	0.1
		Gallons/km^2	2642	528.4	264.2	132.1	52.8	26.4
		Liters/hectare	100	20	10	5	2	1
.001 in (0.02 mm)	Light	Gallons/acre	21.4	4.3	2.1	1.1	0.4	0.2
		Gallons/km^2	5284	1057	528.4	264.2	105.7	52.8
		Liters/hectare	200	40	20	10	4	2
.002 in (0.05 mm)	Light	Gallons/acre	53.5	10.7	5.4	2.7	1.1	0.5
		Gallons/km^2	13210	2642	1321	660.5	264.2	132.1
		Liters/hectare	500	100	50	25	10	5
.004 in (0.1 mm)	Light to moderate	Gallons/acre	107	21.4	10.7	**5.4 ****	2.1	1.1
		Gallons/km^2	26420	5284	2642	1321	528.4	264.2
		Liters/hectare	1000	200	100	50	20	10
.019 in (0.5 mm)	Moderate	Gallons/acre	535	107	53.5	26.8	10.7	5.4
		Gallons/km^2	132100	26420	13210	6605	2642	1321
		Liters/hectare	5000	1000	500	250	100	50
.04 in (1.0 mm)	Moderate to heavy	Gallons/acre	1070	214	107	53.5	21.4	10.7
		Gallons/km^2	264200	52840	26420	13210	5284	2642
		Liters/hectare	10000	2000	1000	500	200	100
.08 in (2.0 mm)	Heavy	Gallons/acre	2140	428	214	107	42.8	21.4
		Gallons/km^2	528400	105680	52840	26420	10568	5284
		Liters/hectare	20000	4000	2000	1000	400	200
0.12 in (3.0 mm)	Heavy	Gallons/acre	3210	642	321	160.5	64.2	32.1
		Gallons/km^2	792600	158520	79260	39630	15852	7926
		Liters/hectare	30000	6000	3000	1500	600	300

* The general formula to use is : 10^4 x area (hectare) x thickness (mm) = volume (liters). Convert liters/hectare to gallons/acre by multiplying by .107, and to gallons/km^2 by multiplying by 26.42. For example, for the 1:1 ratio at 0.01mm thickness: 10^4 (=10,000) x .01mm = 100 liters/hectare. 100 liters/hectare x .107 = 10.7 gallons/acre.
100 liters/hectare x 26.42 = 2642 gallons/km^2. To develop the other dilution ratios, multiply the 1:1 numbers by the appropriate fraction (1:5 ratio, multiply by 1/5 or .2; 1:10 ratio, multiply by 1/10 or .1; 1:20 ratio multiply by 1/20 or .05; 1:50 ratio multiply by 1/50 or .02; 1:100 ratio, multiply by 1/100 or .01). Generate other ratios, for another oil thickness or DOR, in similar fashion. To convert to other units, use the conversion factors in Appendix M.

** This is how the generally-applied 5 gallons/acre number has been generated, assuming a light to moderate oil thickness and a DOR of 1:20. However, the table also makes it apparent that many other ratios may be appropriate depending on the volume or thickness of the spilled oil. How the oil behaves in the environment once it is spilled, and the dispersant application platform chosen, will also add a number of variables the FOSC will need to consider. Please see Discussion Note 9.1 for more information on slick thickness, oil volume, and dosage rate, as well as the the figures in Appendices D.2 and D.3.

D.2 Representative oil concentrations and corresponding average thicknesses

The circled numbers on the vertical lines in the figure above refer to 1, 5 and 20 barrels/acre as representative values for days 1, 2 and 3 following a significant crude oil spill.

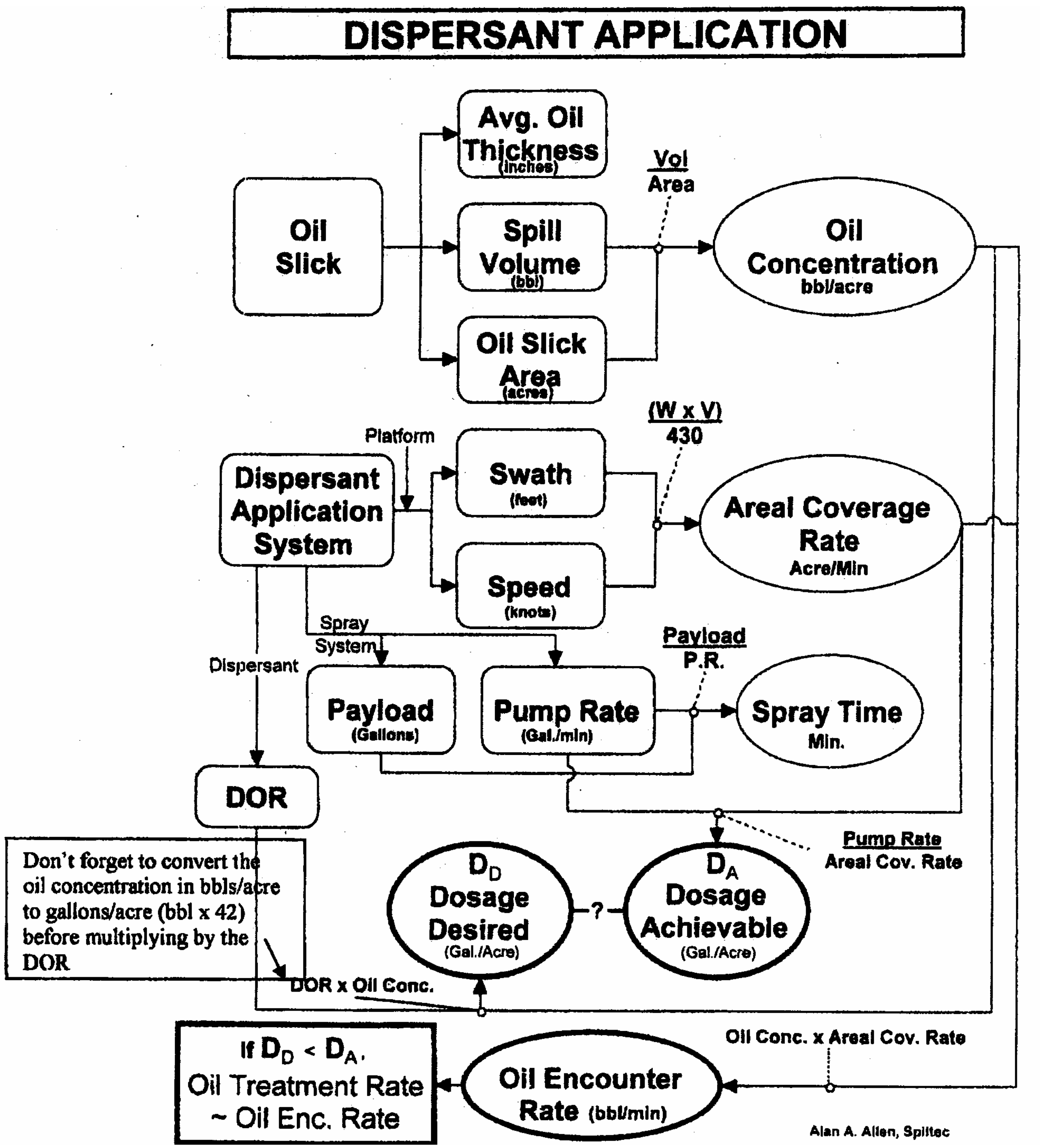


Estimated Volume/Unit Area (bbl/acre)	1	5	20
Average Oil Thickness (inches)	0.0016	0.0077	0.031
Average Oil Thickness (millimeters)	0.039	0.197	0.79

REPRESENTATIVE OIL CONCENTRATIONS & CORRESPONDING AVERAGE THICKNESS
(For Planning Purposes)

From Alan A. Allen (Spiltec), 2003 personal communication

D.3 **Oil slick characteristics and DOR as they apply to the dispersant application system**



D.4 Dispersant Application Summary Form

Incident name: ________________________________ Report number: ___________

This report made by: _____________________________ Organization/agency: ______________________ Date: ___________ Time: _______

Application parameters:

General location of application: ____________________________________

Size of target area: ____________________________________ (m^2/km^2/acres) Circle one

Volume of oil targeted: ____________________________________ (gal/bbl) Circle one
(from Dispersant Pre-Approval Assessment Form)

Dispersant: oil ratio used: ____________________________________

Volume of dispersant required: ____________________________________ (gal/bbl) Circle one
(calculate or use Appendix D.1)

Diagram of application. Include scale, north arrow, location of oil, flight path and application location. Partition this box if multiple passes are expected so that each pass may be sketched.

Application platform:

Aircraft/Boat/Other: ____________________________

Type: ____________________________

Capacity: ____________________________

Pump rate: ____________________________

Swath width: ____________________________

Application speed: ____________________________

Application capacity:

Distance to slick: ____________________________

Base to spill return time: _________________________

Applications per hour: _________________________

Coverage per hour: _________________________

Application details:

Pass number:	Start time	Finish time	Total dispersant applied
1	_______	_______	______________
2	_______	_______	______________
3	_______	_______	______________
4	_______	_______	______________
5	_______	_______	______________
6	_______	_______	______________
7	_______	_______	______________
8	_______	_______	______________
9	_______	_______	______________
10	_______	_______	______________

In part from Cawthron, 2000

D.5 Monitoring dispersant effectiveness

Information in this section is based on the SMART (Special Monitoring of Advanced Response Technologies) Guidelines – a joint project of the U.S. Coast Guard, National Oceanic and Atmospheric Administration (NOAA), US Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention and the Minerals Management Service. Additional information is from the NOAA HAZMAT Report 96-7.

- It is essential to monitor the effectiveness of dispersant applications on oil dispersion.
- It is desirable to monitor the fate of oil, and to assess the impact of dispersed oil on the environment.
- Monitoring intensity should reflect spill size and prevailing conditions, as well as the potential effects of the spill, and logistical and physical constraints. Monitoring intensity should increase with spill size as follows:

Spill size	Visual monitoring	Water column monitoring and sample collection	
		1 m depth	multiple depths
Small	✔		
Medium	✔	✔	
Large	✔	✔	✔

- Visual observation of dispersant effectiveness is the minimum acceptable level of monitoring.
- Termination of dispersant operations should, wherever possible, be based on real-time on-site water column monitoring results from at least one depth.
- Monitoring at multiple depths (either with real-time data or samples collected for later analysis) will provide the best information on dispersant effectiveness and the fate of dispersed oil.

Mobilizing monitoring resources

- It is imperative that monitoring teams and technical advisors are notified of possible dispersant use, and are mobilized as soon as possible (see **Box 1a).**
- Dedicated monitoring staff should be appointed and should not be expected to perform other operational functions.

Visual observation

- Visual observation from aircraft is the most reliable technique for detecting and mapping oil distribution.
- General aerial observation objectives include mapping the distribution and appearance of the oil, verifying the modeled forecast of oil movement, providing responders with an overview of the incident, and directing cleanup operations.
- Observations should be made using the General Observation Guidelines (Appendix D.4), Dispersant Observation Checklist (Appendix D.5) and Dispersant Observation Report Form (Appendix D.6).
- Observations should be photographed and/or videotaped for comparison and documentation.
- Oil close to the coastline is best viewed from a helicopter, ideally with a door or window removed allowing the observer to look straight down on the oil.
- For oil further offshore, multi-engine aircraft provide a longer range, higher speeds and wider margin of safety.
- As a minimum, the aircraft should have space for two observers (excluding the pilot), visibility from both sides, pilot-observer communications, and sufficient navigational aids to follow the proposed flight path.
- Prior to take-off, the observer should be aware of aircraft safety procedures, be familiar with the general spill area, have appropriate maps or nautical charts to record spill details, and know the environmental conditions likely to be encountered.
- Visibility, surface wind speed and direction, and sea state are all important for predicting oil movement and interpreting visual observations. Poor viewing conditions (*e.g.*, fog, rain, or overwashing in rough seas) can prevent observers from seeing the entire spill. Strong winds could indicate emulsification rates may be more rapid than anticipated.
- Advanced sensing instruments (*e.g.*, infrared thermal imaging, side-looking airborne radar, laser fluorescence, microwave radiometer, infrared-ultraviolet line scanner, LANDSAT satellite systems) can provide a high

degree of sensitivity in determining dispersant effectiveness. Problems associated with each of these systems preclude their exclusive use during oil spills. Visual observations cannot always confirm that the oil is dispersed, and physical sampling of water beneath the slick may also be required.

Water column fluorometry and water samples

- Dispersant effectiveness can be confirmed in real-time by monitoring hydrocarbons in the water column using fluorometry.
- For medium and large spills, on-site monitoring is the preferred method for determining whether there is a significant difference between natural and chemical dispersion, and for deciding when dispersant operations should cease. It also provides the best means for determining the volume of chemically dispersed oil.
- Samples should ideally be collected at multiple depths from:
  - Water free of oil contamination (reference or control sites)
  - Water beneath the oil spill before dispersant application (pre-treatment)
  - Water beneath the oil spill after dispersant application (post-treatment)
- The time of sampling, instrument readings, relevant observations at selected time intervals and the exact position of each reading (preferably using Global Position System) must be recorded. Documentation of fluorometer calibration and verified instrument response should also be available.
- The sampling regime will depend on the availability of monitoring resources, the spill size and the logistical constraints of the response. At a minimum, sufficient samples are needed to characterize pre- and post-treatment differences relative to reference sites.
- As fluorometry measures natural fluorescence and not just oil, water samples should also be collected to allow fluorometry results to be related to measured oil concentrations. Fluorometry measures should be made using a continuous flow fluorometer. Water samples should be collected at the outlet port of the flow-trhough water duct, past the fluorometer cell. Water samples should be kept in a cool dark place prior to laboratory analysis.

Fate of dispersed oil

- Monitoring the track of the dispersed oil plume at several depths allows the dilution rate for the dispersed oil to be assessed, and the determination of the rate that hydrocarbon levels in the water column return to background levels.
- Trajectory models should be used where available to assist in tracking the plume. Dye markers can also be used.
- Oil fate monitoring requires:
  - Simultaneous monitoring from a single vessel using independent set-ups from at least two depths.
  - Collection of water samples to validate the fluorometer readings.
  - Wherever possible, measurement of water quality parameters (*e.g.*, temperature, conductivity, dissolved oxygen, pH, turbidity) to help explain the behavior of the dispersed oil.

Using and interpreting monitoring results

- Fluorometry readings will vary widely, reflecting the patchiness and inconsistency of the dispersed oil plume.
- Real-time data are essential if monitoring results are being used to guide dispersant operations and to determine when a response is no longer effective.
- An increase in the fluorometer signal trend beneath chemically dispersed oil of five times or greater than that of readings beneath untreated oil and reference sites is a good indication of dispersion occurring.
- It is important that actual oil concentrations are also measured so that the rate of natural dispersion can be compared to the rate of chemically enhanced dispersion, to determine the actual effect of dispersant use.

From Cawthron, 2000

D.6 General observation guidelines

- Wherever possible, use observers trained and experienced in identifying and quantifying oil floating on the sea;
- Use standard reporting terms (see below) and common guidelines to maintain consistency among observers.

STANDARD TERMS TO DESCRIBE OIL FLOATING ON THE WATER		
1	**Light sheen**	A light, almost transparent layer of oil. Sometimes confused with windrows and natural sheen resulting from biological processes.
2	**Silver sheen**	A slightly thicker layer of oil that appears gray, silvery or shimmers.
3	**Rainbow sheen**	Sheen that reflects colors
4	**Brown oil** (heavy or dull sheen)	Water-in-oil emulsion. Thickness typically 0.1 to 1.0 mm. Can vary depending on wind and current conditions.
5	**Mousse**	Water-in-oil emulsion. Colors can range from orange or tan to dark brown.
6	**Black oil**	Sometimes with a latex texture. Can look like kelp and other natural phenomena.
7	**Windrows** (fingers, stringers, streamers)	Oil or sheen oriented in lines or streaks. Brown oil and mousse can be easily confused with algal scum collecting in convergence lines, algae patches, or kelp.
8	**Tar balls**	Oil weathered into a pliable ball up to 30 cm. Sheen may or may not be present.
9	**Tar mats**	Non-floating mats of oily debris (usually sediment and/or plant matter) found on beaches or just offshore in shallow water.
10	**Pancakes**	Isolated patches of mostly circular oil (size range a few centimeters to 100s of meters in diameter). Sheen may or may not be present.

Oil on the water
- Oil is best viewed with the sun behind the observer, flying at a 30-degree angle to the slick.
- Mid-morning or mid-afternoon viewing is generally best, avoiding midday glare off the water and the limited contrast encountered in early morning or early evening.
- Overall spill dimensions are generally best viewed from an altitude of 1000-2000 feet.
- Estimating oil coverage and color are best from an altitude of 200-300 feet or less.
- Oil surface slicks and plumes can appear different for many reasons including oil or product characteristics, sun angles, viewing angles, type of observation platform, weather, light conditions, sea state, and dispersion rate.
- Waves, kelp beds, natural organics, pollen, plankton blooms, cloud shadows, jellyfish and algae can all look like oil under certain conditions.
- Low-contrast conditions (*e.g.*, overcast, twilight, haze) make observations difficult.

Dispersant applications
- May have variable effectiveness where different oil concentrations (spill thicknesses) result in variable oil/dispersant ratios being applied.
- May cause herding, temporarily “pushing” the oil together and making the slick appear to shrink, or to disappear from the sea surface for a short time.
- May change the color of an emulsified slick by reducing water content and viscosity.
- May change the shape of the slick, due to the de-emulsification action of the dispersant.
- May modify the spreading rates of oils (treated slicks can cover larger areas).

Dispersed oil plumes
- May not form immediately after dispersant application, especially if the oil is emulsified or there is low mixing energy.
- May not form or be visible at all.
- May be masked by surface oil and sheen or hidden by poor water clarity.
- May be mistaken for other things such as suspended solids.
- Are often highly irregular in shape and concentration.
- Can range in appearance from brown to white or cloudy.

Dispersant effectiveness
- A visible cloud in the water column indicates the dispersant is working
- Differences in the appearance of treated and untreated slicks indicate dispersion is likely.
- Boat wakes may physically part oil, falsely indicating successful dispersion.

D.7 **Dispersant Observation Checklist**

To be completed by dispersant observers on aircraft and vessels before departure

Incident name: ____ Report number:_____

This report by: ______________________ Organization: ___________________ Date: ______ Time: ______

Observer name(s) and organizations: ____
____

Observation platform: Helicopter / aircraft / boat / other (specify): ____________________________
Application platform: Helicopter / aircraft / boat / other (specify): ____________________________

COMMUNICATIONS

	VHF	UHF	Other
Air to air:	____________	____________	____________
Air to vessel:	____________	____________	____________
Air to ground:	____________	____________	____________
Ground to vessel:	____________	____________	____________
Vessel to vessel:	____________	____________	____________

	Aircraft/personnel names	Call sign	ETD to spill	ETA at spill
Sprayer 1:	____________	____________	______	______
Sprayer 2:	____________	____________	______	______
Spotter:	____________	____________	______	______
Observer:	____________	____________	______	______
Command Center:	____________	____________	______	______

DISPERSANT

Name: ____________ Dispersant : oil ratio: ____________
Application altitude (ft): ____________ Dilution prior to application (if any): ____________
Observation altitude (ft): ____________ Application rate: ____________
Circle one: gallons/acre, gallons/km^2, liters/hectare

WEATHER ❑ Sunny ❑ Overcast ❑ Cloudy ❑ Rain ❑ Fog
(Circle units used)

Sea state: ________	Wind speed: ________ knots or mi/hr	Air temp: ______ ºC/ºF
Wave height: ________ m/ft	Wind direction: ________ ºtrue/ºmagnetic	Sea temp: ______ ºC/ºF
Water depth: ________m/ft	Current speed: ________ knots or mi/hr	Salinity: ______ ppt
Visibility: ________nm	Current direction: ________ ºtrue/ºmagnetic	Tide: ______(flood/ebb/slack)

DISPERSANT OBSERVATION EQUIPMENT AND SAFETY CHECKLIST

Observation

- Basemaps, charts
- Clipboard, notebook, reporting forms, checklists
- Pens, pencils
- GPS, spare batteries
- Job aids for visual observation
- Camera, spare film
- Video camera, spare batteries
- Binoculars

Personal safety

- Lifejacket (and exposure suit if required)
- Survival equipments (*e.g.*, flares, locator beacon)

Safety brief

- Safety brief with pilot/skipper
- Purpose of mission
- Operational constraints
  - Area orientation, observation plan
- Trip duration
- Landing or mooring sites
- Radio frequencies and reporting schedule
- Safety features (*e.g.*, emergency locator beacon, fire extinguishers, first aid kit, radios)
- Emergency exit procedures
- Gear deployment (*e.g.*, current drogue, dye)

From Cawthron, 2000

D.8 **Dispersant Observations Report Form**

For recording dispersant observations from aircraft and vessels

Incident name: ______________________________ Report number:_____

This report by: ________________ Organization: ______________ Date: ______ Time: ______

Application start time: ____________ (military time) Viewing difficulties (if any): ________________
Application finish time: ____________ (military time) ________________________________

VISUAL APPEARANCE OF SLICK (use standard definitions and visual guides of oil on water)

Before application	Immediately after application	20 minutes after application
Film roll #: ____________	Film roll #: ____________	Film roll #: ____________
Photo #: ____________	Photo #: ____________	Photo #: ____________

Dispersion cloud observed? ❑ Yes ❑ No
Time taken for cloud to form: ________ minutes

Did oil re-appear (re-coalesce)? ❑ Yes ❑ No
Time taken to reappear: ________ minutes

% of slick treated: ________
% overspray: ________
Estimated % efficiency: ________

Describe any variation in effectiveness across slick:

Describe differences between treated and untreated areas:

Describe any biota present and any effects observed:

General comments/problems encountered:

Recommendations for future applications:

Start position
Latitude: ____________________ north
Longitude: ____________________ west
Distance from shore: ____________ km or miles

Finish position
Latitude: ____________________north
Longitude: ____________________ west
Distance from shore: ____________ km or miles

From Cawthron, 2000

D.9 Wildlife Aerial Survey Form

Incident name: ____ Survey #: ____ Flight # ____
Date: __________ Survey page ____ of ____

Survey Crew: ____________________________________
____
____
____

Survey Equipment: ____________________________
____
____
____

Flight information:
Aircraft type: ______________________________
Start flight local time: __________
End survey local time: __________
End survey local time: __________
End flight local time: __________
Survey altitude range (ft): __________

Physical conditions:
Wind (kts): _________ from direction: ____________
Cloud cover (%): _________ Seastate (wave height): _____ ft

Overall sighting conditions:
☐ Excellent ☐ Very good ☐ Good
☐ Fair ☐ Poor

Sighting #	**Sighting specifics**			**General location**
	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
	Current altitude (ft):			
Comments:				

Wildlife Aerial Survey Form, continued

Incident name: ____ Survey #: ____ Flight # ____
Date: ___________ Survey page ____ of ____

Sighting #	Sighting specifics			General location
	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Comments:				

APPENDIX E

WILDLIFE PROTOCOL RECOMMENDATIONS
FOR AERIAL OVERFLIGHTS DURING DISPERSANT OPERATIONS

(Protocols last edited 12/12/03 by Ben Waltenberger (NOAA); forms last edited 01/05/04 by Ellen Faurot-Daniels (CCC))

Following are the recommendations of the Los Angeles / Long Beach Area Committee, Dispersant Use Subcommittee, on wildlife observation protocols during dispersant application aerial operations. To take into consideration potential differences in equipment availability in different geographic areas, in some cases a hierarchical recommendation has been proposed. This includes “ideal” and “minimum recommended” recommendations for response resources.

The subcommittee researched aerial observation methodologies, including two active aerial wildlife monitoring programs: The California Department of Fish & Game’s “Resources at Risk” aerial monitoring program, and NOAA’s Channel Islands NMS Sanctuary Aerial Monitoring and Spatial Analysis Program (SAMSAP). We used elements from both these programs to assess minimum standards for criteria such as aircraft type, maximum altitudes, crew complements, etc.

Aircraft and Crew

The minimum standard for aircraft type should be a twin-engine, fixed-wing aircraft capable of holding one pilot plus three crewmembers. The design should allow for a wide-field, down-looking view, such as that found on the Partenavia type aircraft. The aircraft should have a minimum two-hour flight endurance. On-board equipment should include a laptop computer with GPS interface; a tape recorder; two pairs of binoculars; a camera (still and video if available); and charts and maps of the survey area.

The ideal wildlife observation solution is a dedicated aircraft with a crew of four: a pilot, a data recorder, and two observers. This arrangement is the best solution for ensuring complete assessment of the biological component in the response area. It is recognized that while a dedicated aircraft is the best solution, it is not necessarily the most practical solution. Variance in available equipment and personnel at a response scene may make a dedicated platform a non-viable alternative. Based on prior evaluations, a list of three observation platform possibilities has been produced. These take into account the most likely scenarios regarding equipment and personnel availability and are listed in order of preference:

1. A dedicated seat for a trained wildlife observer on the dispersant spotter aircraft. The other spotter seat is always reserved for a dedicated dispersant spotter. This scenario has the advantage of making the most out of available resources and platforms. Different jobs could be accomplished during consecutive passes, *e.g.*, the first pass would be for dispersant-related observations, and the second pass would be used for wildlife recording. Additionally, cross-training of spotters could take place so that, as necessary, spotters could switch roles and thus make the most out of available resources.

2. A dedicated wildlife spotter aircraft and crew as outlined at the beginning of this section would be the “ideal” solution from a wildlife spotting perspective.

3. Making a wildlife spotter seat available in the Natural Resource Damage Assessment (NRDA) aircraft. This is the least favored alternative because this aircraft is looking at a broad area and probably flying too late in the spill response for pre-dispersant-application wildlife missions. It would nevertheless have a useful application for counting injured or dead wildlife later in the spill response and/or after dispersant applications have been made, and thus should not be dismissed as a viable alternative.

To ensure adequate equipment and personnel are identified, it is recommended that the RRT develop a list of skilled wildlife spotters and available aircraft throughout California. It is also recommended that a cross-training program be initiated to allow wildlife and dispersant spotters to be used in the most effective and efficient manner. An interim list of potential wildlife observers, drawn from the Wildlife Response Plan, is offered in Appendix E.2.

Wildlife Observer Duties and Responsibilities

The primary role of a dedicated wildlife observer is to collect data and offer suggestions through the dispersant spotter to the Unified Command. The dispersant spotter shall relay these suggestions to the Unified Command, which may or may not accept the suggestions based on other incident specific data. It is nevertheless valuable to agencies and the public to demonstrate that wildlife concerns are addressed during any dispersant application. Observations and suggestions made by the spotters shall also be provided to the NRDA Team on a timely basis for their evaluation and follow-up.

Wildlife surveys should concentrate on the spill's leading edge. Animals in other areas should be noted, but since animals already in a slick will already be casualties or considered as dead, surveys related to dispersant use should concentrate outside the spill perimeter.

In order to efficiently identify animals, the spotter aircraft should fly no higher than 600 feet. Lower altitudes are recommended when possible. The 600-foot ceiling will allow the identification of marine mammals and other larger animals at the species level. Avifauna, except in limited instances of visually unique species, will most likely not be identifiable at the species level from this altitude. Avifauna can, however, be identified at the taxa level at 600 feet. The taxa level identification of avifauna is sufficient for the purpose of dispersant reconnaissance. It should be recognized that due to air traffic or other hazards the spotter aircraft may have to fly at higher than recommended altitudes for periods of time.

For wildlife spotting purposes, aircraft should be flown at the slowest speeds at which they can safely operate unless conditions dictate otherwise.

In the ideal spotter aircraft crew scenarios, the crewmembers should have the following duties:

- Pilot: The pilot's primary role is to fly the aircraft as directed and monitor and avoid other air traffic.

- Data Recorder: The data recorder rides next to the pilot. The recorder's primary function is to record data related to the location of the slick and the location and number of species observed by the spotters during the mission. The data recorder may also act as navigator, using maps, charts, or Geographic Information System (GIS) software tied into the aircraft's GPS. The data recorder's secondary role is to assist in wildlife and slick observation and to help monitor air traffic.

- Spotters (two): A spotter sits on each side of the aircraft behind the pilot and data recorder. The spotters' primary role is to observe the number and species of wildlife and wildlife location in relation to the slick. In some cases, one spotter's primary role will be as a dispersant spotter, the other's role will be to act primarily as a wildlife spotter.

A sample Wildlife Aerial Survey Form appears in E.1 on the following page. A list of experienced aerial wildlife observers is offered in Appendix E.2. Blank wildlife aerial survey forms, suitable for duplication, may be found in Appendix D.9.

E.1 Sample Wildlife Aerial Survey Form

Incident name: *Santa Barbara Mystery Spill 34*
Date: *11Dec03*

Survey #: *1* Flight # *1*
Survey page *1* of *1*

Survey Crew:
Amelia Earhart -- pilot
Joe Computer – data recorder
Bill Byrd – wildlife spotter
Olivia Oyle – dispersant spotter

Survey Equipment:
7 x 50 binoculars
Garmin GPS
Digital camera
Tape recorder

Flight information:
Aircraft type: *Partenavia fixed-wing*
Start flight local time: *1400 PST*
End survey local time: *1415 PST*
End survey local time: *1510 PST*
End flight local time: *1530 PST*
Survey altitude range (ft): *400-1000 ft*

Physical conditions:
Wind (kts): *10-15* from direction: *NW*
Cloud cover (%): *ave. 60%* Seastate (wave height): *1-2* ft

Overall sighting conditions:
☐ Excellent ☐ Very good ☐ Good
☐ Fair ☐ Poor

Sighting #	**Sighting specifics**			**General location**
1	Number of animals:*12*	Lat: *34 23.22 N*	Taxa: *Avian*	*NE corner of spill, 100m from leading edge*
	Local time: *1430*	Long: *119 43.23 W*	Species/ancillary ID info: *Brown pelicans*	
	Current altitude (ft): *450*			
Sighting *2*	Number of animals: *300*	Lat: *34 24.11 N*	Taxa: *Unknown*	Center of spill, in oil
	Local time: *1000*	Long: *119 33.87 W*	Species/ancillary ID info: *UNID small cetaceans*	
	Current altitude (ft): *1000*			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Sighting	Number of animals:	Lat:	Taxa:	
	Local time:	Long:	Species/ancillary ID info:	
	Current altitude (ft):			
Comments:				

E.2 List of experienced aerial wildlife observers

This list is drawn in part from the <u>List of Wildlife Experts and Contractors</u> from Appendix 1b of the Wildlife Response Plan, a stand-alone response resource to use with each of California's Area Contingency Plans. Individuals excerpted from that list are those with aerial wildlife observation experience. Others listed are known to the response community as also having the requisite aerial observation skills and potentially available to help implement the Wildlife Observation Protocols during a dispersant response.

We offer here some of the same insights and caveats found in the Wildlife Response Plan:

> "*In general, the listing is divided into marine birds and marine mammals [experts}, with a few having expertise in near shore terrestrial animals. The list includes individuals who have a history of cooperation with [the California Department of Fish and Game] CDFG (other than individuals already known ... through the Oiled Wildlife Care Network – OWCN). It includes both agency personnel and private consultants statewide. This list is not comprehensive; some qualified individuals or companies may not be included. This list is not an endorsement of the ability of the personnel shown.*
>
> *This list was generated as a resource to [the Office of Spill Prevention and Response] OSPR field responders to aid in addressing wildlife issues and environmental sensitivities during spill response. Individuals on this list may be valuable to a spill response in many ways. For example, 1) local experts will often have site-specific knowledge (e.g., status of local populations, breeding status, abundance, seasonal occurrence) which will be necessary for effective spill response planning, 2) agency personnel shown can assist by recommending individuals from this list or others that may not be listed who may also be willing to participate in the response, 3) staffing Wildlife Reconnaissance functions, and 4) endangered species consultation and monitoring.*
>
> *Generally, all personnel listed, other than agency personnel, have indicated an ability to travel and work statewide. Spills involving endangered species and/or marine mammals will require special expertise. Non-agency affiliated personnel who are shown having expertise with listed species and marine mammals generally have permits and/or MOUs with CDFG, USFWS and/or NMFS."*

While these observers have the training and approvals necessary to assist in wildlife surveys during an oil spill response, they have not yet been separately briefed, pre-trained or vetted relative to the more particular needs of implementing the Wildlife Aerial Observation Protocols during a dispersant application.

This is a preliminary list that will be updated once experienced observers have been identified, trained in the specific dispersant-related Wildlife Observation Protocols, and vetted by the responsible federal and state trustee agencies. This list below is offered for the interim.

E.2 List of wildlife experts potentially able to assist in dispersant-related implementation of the WILDLIFE OBSERVATION PROTOCOLS

Name (* Info not verified)	**Specialty/Geographic Area Covered**	**Agency/Company/ Organization**	**Contact Numbers**
Adams, Josh	Seabird capture, handling, ID, at-sea survey, radio telemetry, Monterey Bay to San Mateo county coast.	USGS	Work: 831-771-4422 Cell: Home: 831-684-9317 Emergency: home Email: Josh_Adams@usgs.gov
Ainley, David*	Seabirds, boat surveys	Harvey and Associates	Work: 408-263-1814 or 415-332-5718 Cell: Home: Emergency: Email:
Ames, Jack	Sea otters, oil spills, boat/shore/aerial sea otter surveys	CDFG-OSPR	Work: 831-469-1740 Cell: 831-212-7010 Pager: 408-939-5489 Home: 831-633-5294 Emergency: pager or cell Email: james@ospr.dfg.ca.gov
Anderson, Dan*	California brown pelican, waterbirds, pollution ecology	University of California	Work: 530-752-2108 Dept. office: 530-752-6586
Applegete, Tom	Shorebirds, California least tern, western snowy plover, waterfowl, SLO and Santa Barbara counties	Wildwing	Work: 805-764-2780 Cell: 805-235-1728 Home: Emergency: work or cell Email: wildwing@onemain.com
Boyce, Jennifer*	Seabirds, oil spills	NOAA, Restoration Center	Work: 562-980-4086 Cell: Home: Emergency: Email: Jennifer.boyce@noaa.gov
Buffa, Joelle	Wildlife, seabirds	USFWS	Work: 510-792-0222 x 32 Cell: 510-377-5958 Home: Emergency: Email: joelle_buffa@fws.gov
Burkett, Esther*	Marbled murrelet	CDFG-HCPB	Work: 916-654-4273 Cell: Home: Emergency: Email: eburkett@dfg.ca.gov
Colwell, Mark	Shorebirds, waterbirds	Humboldt State University	Work: 707-826-3723 Cell: Home: 707-822-7309 Emergency: home Email:
Copper, Elizabeth	California least tern	Avian Research Associates	Work: 619-435-1340 or 619-435-1355 Cell: Home: Emergency: Email:
Ford, Glenn	Seabirds	R.G. Ford Consulting	Work: 503-287-5173 Cell: 503-282-0799 Home: Emergency: Email: eci@teleport.com

E.2, continued List of wildlife experts potentially able to assist in dispersant-related implementation of the WILDLIFE OBSERVATION PROTOCOLS

Name (* Info not verified)	Specialty/Geographic Area Covered	Agency/Company/ Organization	Contact Numbers
Garrett, Kimball	Birds	Los Angeles County Museum of Natural History	Work: 213-763-3368 Cell: Home: Emergency: Email: kgarrett@nhm.org
Golightly, Rick	Seabirds, seabird colonies, oil spills	USGS-BRD	Work: 707-826-3952 Cell: Home: Emergency: Email:
Gorbics, Carol	Seabirds and sea otters. Alternate to Katy Zeeman.	USFWS	Work: 760-431-9940 x 214 Cell: 760-271-6934 Home: 760-804-3984 Emergency: Email:
Gress, Frank*	Seabirds, California brown pelican	CA Institute of Environmental study	Work: 530-756-6944 or 530-756-1175 Cell: Home: Emergency: Email; fgress@pacbell.net
Harvey, Jim*	Seabird and shorebird surveys, seabird and pinniped handling, marine mammals, Santa Cruz and Monterey counties	Moss Landing Marine Labs	Work: 831-632-4400 Cell: Home: Emergency: Email: harvey@mlml.calstate.edu
Haulena, Martin	Marine mammals and sea turtles, Mendocino to SLO counties	The marine Mammal Center	Work: 415-289-7370 Cell: 415-819-2254 Home: Emergency: pager Email: haulenam@tmmc.org
Hewitt, Rob	Western snowy plover, bird ID, local avifauna, California and southern Oregon	LBJ Enterprises	Work: 707-442-0339 Cell: 707-845-3189 Home: 707-269-0271 Emergency: home or cell Email: lbjent@humboldt1.com
Imai, Randy	Aerial wildlife observations, oil spill mapping and technology	CDFG-OSPR	Work: 916-324-0000 Cell: 916-826-5271 Pager: 916-360-2232 Home: Emergency: pager or cell Email: rimai@ospr.dfg.ca.gov
Jurek, Ron*	Snowy plover, least tern, shorebirds, birds, raptors	CDFG-HCPB	Work: 916-654-4267 Cell: Home: Emergency: Email: rjurek@dfg.ca.gov
Keane, Kathy	California least tern	Keane Biological Consultants	Work: 562-425-8565 Cell: 562-708-7657 Home: Emergency: Email: keanebioco@aol.com

E.2, continued — List of wildlife experts potentially able to assist in dispersant-related implementation of the WILDLIFE OBSERVATION PROTOCOLS

Name (* Info not verified)	**Specialty/Geographic Area Covered**	**Agency/Company/ Organization**	**Contact Numbers**
Kelly, Paul	Seabirds, seabird conservation and management, oil spills	CDFG-OSPR	Work: 916-323-4335 Cell: 916-202-3685 Pager: 916-328-3201 Home: Emergency: cell or pager Email: pkelly@ospr.dfg.ca.gov
Kovacs, Karen*	Wildlife, waterbirds	CDFG-Eureka	Work: 707-445-6493 Cell: Home: Emergency: Email: kkovacs@dfg.ca.gov
LeValley, Ron	Waterbirds, marbled murrelet, snowy plover	Mad River Biologists	Work: 707-839-0900 Cell: 707-496-3326 Home: Emergency: Email:
McAllister, Sean	Waterbirds, marbled murrelet, snowy plover, oil spills	Mad River Biologists	Work: 707-839-0900 Cell: Home: Emergency: Email: sean@madriverbio.com
McChesney, Gerry	Seabirds, seabird colonies, oil spills	USFWS, San Francisco Bay NWR	Work: 510-792-0717 Cell: Home: Emergency: Email:
McCrary, Michael	Marine birds, oil spills, mammals	MMS, Pacific OCS office	Work: 805-389-7851 Cell: Home: Emergency: Email:
Nevins, Hannah	Seabird and shorebird surveys, seabird and pinniped handling	Moss Landing Marine Labs	Work: 831-771-4422 Cell: Home: Emergency: home Email: hrnevins@hotmail.com
Ralph, C.J.	Marbled murrelet, seabirds, oil spills	US Forest Service	Work: 707-825-2992 Cell: Home: 707-822-2015 Emergency: Email: jcr2@homboldt.edu or cjralph@humboldt1.com
Roletto, Jan	Wildlife, marine mammals, oil spills	Gulf of the Farallones NMS	Work: 415-561-6622 Cell: home: Emergency: Email: j.roletto@noaa.gov

E.2, continued List of wildlife experts potentially able to assist in dispersant-related implementation of WILDLIFE OBSERVATION PROTOCOLS

Name (* Info not verified)	Specialty/Geographic Area Covered	Agency/Company/ Organization	Contact Numbers
Sharp, Brian	Waterbirds, oil spills	Sharp	Work: 541-763-2050 Cell: Home: Emergency: Email:
Singer, Steve	Marbled murrelet, birds	Singer	Work: 831-427-3297 Cell: Home: Emergency: Email:
Strong, Craig	Seabirds, shorebirds, special expertise with brown pelicans, waterfowl, marine mammals and marbled murrelet; west coast, San Diego-WA, Del Norte and Humboldt counties	Crescent Coastal Research	Work: 503-338-6023 Cell: 503-791-0509 Home: 503-338-5510 Emergency: home Email cstrong@pacifier.com
Swanson, Jim	Region 3 biologist	CDFG	Work: 707-944-5528 Cell: Home: Emergency: Email: jswanson@dfg.ca.gov
Sydeman, Bill*	Birds, oil spills	Point Reyes Bird Observatory	Work: 415-868-1221 Cell: Home: Emergency: Email: waterislife@hotmail.com
Tershey, Bernie	Seabirds	Island Conservation, Center for Ocean Health	Work: 831-459-1461 Cell: Home: Emergency: Email: tershey@islandconservation.org
Zeeman, Katy	Endangered species, wildlife, sea otters; Ventura through San Diego counties	USFWS	Work: 760-431-9440 x 291 Cell: Home: Emergency: Email:
Other Experienced Observers			
Boggs-Blalack, Melissa	Regional marine biologist, oil spills	CDFG-OSPR	Work: 805-772-1756 Cell: 805-558-1005 Pager: 805-614-2106 Home: Emergency: cell or pater Email: mboggs@ospr.dfg.ca.gov
Croll, Don	Seabird identification, surveys	University of California Santa Cruz, Center for Ocean Health	Work: 831-459-3610 Cell: Home: Emergency: Email: croll@biology.ucsc.edu
DeVogeleare, Andrew	MBNMS marine research director	Monterey Bay National Marine Sanctuary	Work: 831-647-4213 Cell: Home: Emergency: Email: andrew.p.devoglaere@noaa.gov

List of wildlife experts potentially able to assist in dispersant-related implementation of WILDLIFE OBSERVATION PROTOCOLS

Name (* Info not verified)	**Specialty/Geographic Area Covered**	**Agency/Company/ Organization**	**Contact Numbers**
Espinosa, Larry	Regional marine biologist, oil spills	CDFG-OSPR	Work: 831-649-2888 Cell: 831-234-5127 Pager: 408-939-6032 Home: Emergency: Email:
Faurot-Daniels, Ellen	Land/boat/aerial sea otter surveys, oil spills, marine biologist, supervisor	California Coastal Commission	Work: 415-904-5285 or 831-427-4852 Cell: 831-334-2134 Pager: 415-201-5792 Home: 831-726-1750 Emergency: pager Email: efaurotdaniels@coastal.ca.gov
Harris, Mike	Land/boat/aerial sea otter surveys	CDFG-OSPR	Work: 805-772-135 Cell: 831-212-7090 Pager: 805-348-9316 Home: Emergency: cell or pager Email: mharris@ospr.dfg.ca.gov
Hatfield, Brian	Land/boat/aerial sea otter surveys	USGS-BRD	Work: 805-927-3893 Cell: Home: Emergency: Email: brian_hatfield@usgs.gov
Kenner, Mike	Land/boat/aerial sea otter surveys	USGS-BRD	Work: 831-459-3244 Cell: Home: Emergency: Email:
Kieckhefer, Tom	Cetaceans and sea otters	Pacific Cetacean Group and Friends of the Sea Otter	Work: 831-582-1030 or 831-373-2747 Cell: Home: Emergency: Email: kieckhefer@aol.com or education@seaotters.org
Lewis, Robin	Regional marine biologist and supervisor, oil spills	CDFG-OSPR	Work: 858-467-4215 Cell: 619-972-0507 Pager: 619-893-2969 Home: Emergency: cell or pager Email: rlewis@ospr.dfg.ca.gov
Nordhausen, Walter	Regional marine biologist, oil spills	CDFG-OSPR	Work: 858-637-5515 Cell: 858-414-8512 Pager: 858-769-2997 Home: Emergency: cell or pager Email: wnordhau@ospr.dfg.ca.gov
Staedler, Michelle	Land/boat/aerial sea otter surveys	Monterey Bay Aquarium	Work: 831-648-4976 Cell: 831-332-0086 Pager: Home: Emergency: Email: mstaedler@mbayaq.org

E.2, continued **List of wildlife experts potentially able to assist in dispersant-related implementation of WILDLIFE OBSERVATION PROTOCOLS**

Name (* Info not verified)	**Specialty/Geographic Area Covered**	**Agency/Company/ Organization**	**Contact Numbers**
Stewart, Julie	Land/boat/aerial sea otter surveys	Monterey Bay Aquarium	Work: Cell: 831-254-0949 Pager: Home: Emergency: Email: jstewart@mbayaq.org
Tarpley, John	Regional marine biologist and supervisor, oil spills	CDFG-OSPR	Work: 707-864-4906 Cell: 707-232-9841 Pager: 707-288-8071 Home: Emergency: cell or pager Email: jtarpley@ospr.dfg.ca.gov
Tinker, Tim	Land/boat/aerial sea otter surveys	UC Santa Cruz	Work: 831-459-2357 Cell: 831-254-9748 Pager: Home: Emergency: Email: tinker@biology.ucsc.edu
Waltenberger, Ben	Marine bird, mammal and sea turtle aerial surveys	Channel Island NMS	Work: 805-966-7107 x 461 Cell: 805-729-3082 Pager: 877-982-2617 Home: Emergency: pager Email: ben.waltenberger@noaa.gov
Wiese, Kris	Regional marine biologist, oil spills	CDFG-OSPR	Work: 707-441-5762 Cell: 707-888-8980 Pager: 707-288-0871 Home: Emergency: cell or pager Email: kwiese@ospr.dfg.ca.gov
Wilson, Ken	Regional marine biologist, oil spills	CDFG-OSPR	Work: 805-568-1229 Cell: 805-558-1006 Pager: 805-683-5067 Home: Emergency: cell or pager Email: kwilson@ospr.dfg.ca.gov

APPENDIX F

PUBLIC COMMUNICATIONS PLAN

F.1 Sample Press Release

(Still being completed)

F.2 General risk communication guidelines

- **Know the stakeholders**

  Identifying both external and internal stakeholders and finding out their diverse and sometimes competing interests and concerns is the first step to any successful risk communication effort. The best way to determine stakeholder interests and concerns is to ask them! Conduct interviews with key leaders both outside and inside your organization. Use the information gathered in this step to develop your risk communication program for establishing collaborative problem-solving and communication efforts.

- **Simplify language and presentation, not content**

  When trying to communicate the complex issues behind a health risk, it is easy to leave out information that seems to be overly technical. Risk communication research and studies have proven that all audience members can understand any technical subject if it is presented properly. This can be done, for example, through the use of visuals and diagrams and by defining all technical, medical and scientific jargon and acronyms.

- **Be objective, not subjective**

  It is often very easy to differentiate between opinions and facts. It can be difficult, however, to respond credibly to opinions without substantiating them or offending the individual asking the question. In order to maintain credibility, respond to both opinions and facts in the same manner.

- **Communicate clearly and honestly**

  To communicate clearly, present information at the audience's level of understanding. People can reject information that is too difficult for them or they can reject a communicator who is perceived to be dishonest or untrustworthy. As a result, they may refuse to acknowledge the information or become hostile. On the other hand, they may become hostile if they feel patronized. The bottom line is – know the audience! In addition, whenever possible, provide familiar examples and concrete information that can help put the risk in perspective.

- **Deal with uncertainty**

  When communicating health risks, results are not definitive. Discuss sources of uncertainty, such as how the data were gathered, how they were analyzed, and how the results were interpreted. This demonstrates that the uncertainties are recognized, which can lead to an increase in trust and credibility. However, when discussing uncertainty, the communicator should stress his or her expertise and knowledge of the subject. This will reinforce the leadership's ability to handle the situation and could allay concerns and fears regarding the risk and the risk-management decision.

- **Be cautious when using risk comparisons**

  In order to put risks in perspective, comparing an unfamiliar risk to a familiar one can be helpful. However, some types of comparisons can alienate audience members. Avoid comparing unrelated risks, such as the risks associated with smoking versus those associated with air contamination. People rarely accept the comparison of unrelated risk.

- **Develop key messages**

  Key messages are those items of importance, the health risk information that needs to be communicated. They must be clear, concise, and to-the-point. No more than three messages should be communicated at one time. Repeat key messages as often as possible to ensure they are not misunderstood or misinterpreted.

- **Be prepared**

  Most questions and concerns can be anticipated if the audience is known. In fact, the communicator should know 70 percent of the possible questions that could be asked. Consider how to answer general questions and how to respond to specific inquiries.

F.3 Risk communication guide for state or local agencies

Much of the following is excerpted from "Risk Communication Guide for State and Local Agencies", produced be the California state Office of Emergency Services (October 2001). The full copy of the report can be requested from Yvonne Addassi (OSPR; see Appendix A) or by accessing the following internet web site:
http://www.oes.ca.gov/oeshomep.nsf/all/RiskGuide/$file/RiskGuide.pdf

Key risk issues often of interest to the community

- Consequences of worst-case and alternative scenarios and the likelihood of disaster.
- Local government and community emergency response actions, and how those have been factored into state and federal response actions.
- Community notification systems.
- Perceived risks as reported by the media.
- Use of standards and accepted practices.
- Safety thresholds and limits.
- Acceptance of the decision process and decisions by the technical, scientific and environmental communities
- Other potential considerations (*e.g*., business (including commercial fishing and tourism) and recreation (including fishing and beach access) impacts.

- Pay as much attention to community outrage factors, and to the community's concerns, as you do to scientific data. At the same time, do not underestimate the public's ability to understand technical information.

General risk perception and communication issues

- Risks under individual control are accepted more readily than those subject to industry or government control.

  At the time of an actual spill response and/or a decision to use dispersants, response actions will be directed by the Unified Command. It is important that during an oil spill emergency response, actions taken are quick, well-considered, yet nevertheless directive. To offset public unease at how heavy-handed this may seem, it will be helpful to briefly review how various stakeholder groups and the public were included in preceding dispersant response <u>planning</u> process, and how the current dispersant decision is being guided by real-time data gathering. Also include information on other agency consultations, and how particular concerns about living resources, fishery impacts, and socioeconomic impacts will be addressed.

- Risks that seem fair are more acceptable than those that seem unfair.

  It may be helpful to explain the Net Environmental Benefit Analysis process that was used in the response planning phase. At that time, it was determined that 1) harm would occur as a result of a spill, and 2) the goal is to minimize the overall harm and spare the most sensitive resources, and provide a <u>net</u> environmental benefit. However, the communicator will also need to address questions of impacts to business and coastal and ocean access, as these were not considered at the time that net environmental benefits were being weighed during the planning process.

- Risk information that comes from trustworthy sources is more readily believed than information from untrustworthy sources.

  Use the guidance offered above in Appendix F.2.

- Exotic risks seem more dangerous than familiar risks.

  Use of dispersants in California is not yet a common oil spill response practice. The public will expect to see that all other means to recover oil using the more traditional mechanical means have been considered. They also need to understand the circumstances under which dispersants may cause less harm to the environment than would those more traditional mechanical recovery tools, and how all means to recover and/or re-locate the oil to less sensitive environmental "compartments" will be used.

- Risks that are "undetectable" are perceived as more dangerous.

  It is extremely likely that the public will interpret a decision to use dispersants as a decision to "hide" the oil. These concerns need to be addressed openly and honestly, drawing on the communication tools in Appendix F.2 as well as the resource impact information generated during the dispersant Net Environmental Benefit Analysis response planning process.

Possible objectives of a risk communication program

- Research the issues with stakeholders to gather sufficient information to identify the most important risk communication objectives to address.
- Identifying the stakeholders to anticipate or assess their varying interests, in order to design an effective risk communication program is a critical initial task.
- Stakeholders can include the residential, business, commercial or industrial communities, your agency and other agencies (local and state governments, special districts), environmental groups, and general interested members of the public. Media members may also be present.
- The level of stakeholder interest is a driving force in the assignment of risk communication priorities -- properly identifying and understanding all stakeholder objectives will enhance risk communication effectiveness.
- Communication objectives may include:
  - informing the community, seeking input or feedback, clarifying the probability and consequences of potential risks, addressing existing controversies or concerns, providing a forum for discussion, improving stakeholder understanding and support of government decisions, clarifying agency roles in controlling risk, coordinating federal and state emergency response plans with local government and business emergency response plans, and satisfying regulatory requirements to communicate risk.
- Potentially important objectives during and after the incident include:
  - retaining credibility and trust, clarifying how the current incident compares to the previously assessed risk, identifying how lessons-learned will be used to decrease risks and consequences in the future, and providing enhancements to future community emergency response.

Defining effective risk communication activities during and after incidents

- If an incident was noticed by or impacted the public, time is of the essence in providing information to the community.
- Several communication media (*e.g*., newspapers, television, radio, technical journals) will be readily available, but not necessarily controllable.
- The community will gauge the success of the incident investigation efforts and control of causal factors by how much information is communicated to the community.
- If there is a high degree of uncertainty, focus the risk communication effort on what is being done to control the emergency. Keep the communication channels open.
- Contact news media to provide information. See "**Guidelines for meeting with the media**" below. If there is uncertainty with respect to event chronology or causes, release the information prudently and properly identify that the information is preliminary, but additional information will be provided as it becomes available.
- After an incident:
  - Ensure that any preliminary information has been verified, clarified or modified so that future references to the incident will be factual.
  - Follow-up with local and regional media to verify key information and provide a close-out mechanism for the spill response.
  - Be honest and candid with the public and media, using the guidelines in Appendix F.2.a

Choosing the right representatives

- Use field/community relations staff to relay community concerns within the agency.
- Choose carefully those who represent the agency, and provide appropriate support (e.g.
- Technically-qualified people should have a major role in risk communication.
- For effective communication, representatives need to address <u>technical</u>, <u>communication</u> and <u>authority</u> issues.
- If possible, use the same agency representative throughout the life of the event.
- In some situations, a non-agency representative may be more useful than someone from inside an agency.

Responding personally

- When you speak at a public meeting, tell people who you are, what your background is, and why you are there.
- When speaking personally, put your views into the context of your own values, and urge your audience to do the same.
- If your personal position does not agree with agency policy, do not misrepresent yourself or mislead the community.
- Prepare responses to potential questions before the meeting.

F.3, continued

Creating and maintaining trust and credibility during and after an incident

- Maintain open channels of communication.
- Provide critical information promptly.
- Ensure that the public receives a clear message that the emergency responders are taking appropriate actions to mitigate the event.
- Provide a resource for the public to call to secure additional information.
- Take appropriate steps to promptly investigate the cause of the event.
- Ensure that the public receives a clear message that an investigation of the incident was performed and appropriate actions to prevent a future incident were identified for implementation.
- Provide appropriate follow-up information and follow through with any commitments to the community.
- Recognize that people's values and feelings are a legitimate aspect of public health and safety issues and that such concerns may convey valuable information.
- When people are speaking emotionally, respond to their emotions. Do not merely respond with data.
- Be aware of your own values and feelings about an issue and the effect they have on you.
- Empathetic words will be effective only if your tone of voice, body language and demeanor reinforce what you are saying.

Guidelines for meeting with the media

- Be prepared. Plan what you want to say and anticipate reporter's questions.
- Take and keep control. You decide where to be interviewed. Bridge to your points or to turn negative questions into positive responses. Don't repeat negatives. Know when to exit the interview.
- Make your point. Bring your own agenda to the interview. Stress positive aspects of your operation.
- Keep your composure and watch your body language. Look and sound like you want to be there. Be cooperative, not combative. Avoid a defensive appearance.
- Don't speculate. If you do not have an answer, say so. Do not answer hypothetical questions. Do not feel all questions must be answered immediately.
- Never say "No Comment". Give sound reasons why you cannot answer a question (proprietary information, lack of authority, etc.).
- Never go "Off the Record". Anything you say may be reported. Do not be tricked into answering a question when a reporter says he has turned off a microphone or camera.

F.4 Planning a public meeting: Checklist

As discussed in Appendix F.3, public meetings are one way to involve the community stakeholders in your agency's spill response communications plan. They can be organized in many different ways, depending on the goal, topic, audience and other factors. This checklist will help with general elements that would apply to most public meetings.

PUBLIC MEETING CHECKLIST

MEETING PURPOSE

Organizations and individuals identified? ❑Yes ❑ No
Interests identified and categorized? ❑Yes ❑ No

Meeting time: ________________
Date: ________________
Hours: ________________
Meeting place(s): ________________
Address: ________________
____

Central location? ❑Yes ❑ No
Public transportation access? ❑Yes ❑ No
Suitable parking? ❑Yes ❑ No
Safe area? ❑Yes ❑ No
Adequate space? ❑Yes ❑ No
Adequate facilities? ❑Yes (No

Total expected:
No

General session planned? (Yes (No
Number of small groups/number in each: /

Agenda questions developed? (Yes (No
Schedule developed? (Yes (No
No
Stakeholder interest topics included? (Yes (No
(No
Speakers and speaker order identified? (Yes (No

INFORMATION DEVELOPMENT AND PRESENTATION

Information to be provided:

Written information completed? (Yes (No
(No
Role for moderator identified? (Yes (No
(No
Moderator rehearsed? (Yes (No
(No

PUBLICITY

Methods selected: ________________
____
____

Material prepared? ❑Yes ❑ No
Number of copies: ________________
Material distributed? ❑Yes ❑ No
Personal follow-up? ❑Yes ❑ No
PIO/JIC contacted? ❑Yes ❑ No
Message developed? ❑Yes ❑ No
Message approved? ❑Yes ❑ No
Answers prepared? ❑Yes ❑ No
Press release issued? ❑Yes ❑ No

MEETING ARRANGEMENTS

Tables, chairs, lecterns (Yes (No
obtained?
Audio/visual equipment (Yes (

obtained?
Registration table? (Yes (No
Name tags? (Yes (No
Refreshments? (Yes (No
Heating & cooling OK?(Yes (No
Sound & lights OK? (Yes (

Pens, pencils, flipcharts? (Yes

RECORDING THE PROCEEDINGS

Methods:

Moderators:
Meeting evaluation tools:

Recommendations made? (Yes
Recommendations taken? (Yes
Post-meeting report to (Yes

public made?

F.5 Dispersant fact sheet

Include in press packet, distribute at public meetings, or use for other general background briefing and information purposes.

Oil Spill Dispersants

One tool used occasionally in oil spill response is chemical dispersants. Under strict approvals and a narrow set of conditions, dispersants can be sprayed from planes, helicopters or boats onto oil spills in California marine waters. Chemical dispersants break a slick into smaller droplets, promoting mixture of oil into the water column, and accelerating dilution and biological degradation.

Conditions of use

- Federal and state approval for dispersant applications in California is considered when an effective conventional response is not feasible or not totally adequate in containing or controlling the spill.
- Before dispersants are used the response agencies will use all real-time information at their disposal to determine the resources at probable risk from both the oil and the dispersants used against it. Any dispersant application must follow strict guidelines laid down by several agencies and the groups, biologists and community members that assist with advice to those agencies. The federal and state response agencies will make every effort to communicate their oil spill response decisions to the public, through the media and/or in public meetings.
- The primary oil spill response method used in California is mechanical containment and recovery, which involves the use of containment booms, skimmers and other related equipment. The many hindrances to spill recovery, however, place a real advantage to having many “tools in the toolbox”, as historically, no more than 10 percent of the oil has been recovered from large marine spills. Current mechanical technology is not effective in waves greater than about 6 feet, winds greater than 20 knows, or currents greater than 1 knot.
- Dispersants are best used to protect shorelines, when the damage to the shore and nearby marine life would be worse than dispersing the oil into deeper offshore water.
- Dispersants are best used on the leading edge of oil slicks, which might otherwise get out of control and head toward shore.
- Dispersants must be applied soon after the oil is spilled and before the oil weathers or the slick is broken up. This usually means dispersant application with a matter of several hours to a few days, depending on spilled oil circumstances.
- The best conditions are whet the water is deep and when there is sufficient mixing action from waves, wind or current.

How dispersants work

- Dispersants help prevent formation of water-oil emulsions, or mousse, and they speed up biological breakdown of oil by natural marine organisms. They also ability of oil to stick to sediments and other organisms in the water.

Limitations on dispersant application

- Only dispersants approved by federal and California state governments can be used, and only on oils that have a fairly high likelihood of being “dispersible”.
- Ocean and weather conditions must be conducive to dispersant use.
- The spilled oil must be at least 3 miles from shore and not within a National Marine Sanctuary, or other agency approvals will be required before they can be used.
- Dispersant use must be considered to provide a “net environmental benefit” – in other words, once the oil is spilled, resources somewhere are going to be negatively impacted, so the goal is to minimize impacts to the most sensitive resources in the area at the time of the spill.
- Dispersants have to be applied safely, and dispersants cannot continue to be used if they are not effective.

APPENDIX G

SEAFOOD TAINTING PLAN

G.1 Overview for Managing Seafood Concerns During an Oil Spill

The following material is drawn largely from three documents:

Mearns, A.J. & R.Yender, 1997. A summary of a NOAA workshop on management of seafood issues during an oil spill response. Proc. Arctic and Marine Oil Spill Program Technical Seminar. Environment Canada, Vancouver, pp. 203-214.

Reilly, T.I. and R.K York. 2001. Guidance on Sensory Testing and Monitoring of Seafood for Presence of Petroleum Taint Following an Oil Spill. NOAA Technical Memorandum NOS OR&R 9.107pp.

Yender,R., J. Michel, and C. Lord. 2002. Managing Seafood Safety After an Oil Spill Seattle: Hazardous Materials Response Division., Office of Response and Restoration, National Oceanic and Atmospheric Administration. 72 pp.

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Seafood safety is a concern raised at nearly every oil spill incident of any significance. Both actual and potential contamination of seafood can substantially affect commercial and recreational fishing, subsistence seafood use and generate public health concerns. Loss of confidence in seafood safety and quality can impact seafood markets long after any actual risk to seafood from a spill has subsided, resulting in serious economic consequences. Protecting consumers from unpalatable and unsafe seafood is a primary objective of federal and state public health agencies after a spill occurs. Seafood managers may be faced with making many urgent decisions after an oil spill, often based on limited data:

Should seafood harvest in the spill area be closed or restricted?
If closed, what criteria should be applied to re-open a fishery?
How should seafood safety and palatability be evaluated?
How can health risks best be communicated to the public?

Public health officials and other seafood managers do not routinely deal with oil spills as part of their day-to-day responsibilities. Consequently, they typically have little experience with risks to seafood from oil spills when they suddenly are faced with determining appropriate seafood management actions in response to a spill.

Subsequent to an oil spill, there are three separate areas of concern that are often grouped together under the broad definition of "seafood tainting." The Unified Command will need to adequately address each issue in turn as well as the pertinent stakeholders. These three areas can be loosely outlined as follows:

- **Seafood Tainting Concerns**: Contamination of seafood can usually be detected as a petroleum taste, or taint. Public confidence in seafood products can quickly erode as a result of suspect, or actually contaminated products reach the market. The presence of taint simply indicates that flavor or odor is altered; it does not characterize the nature of the off-flavor or off-odor, quantify the degree of taint, or imply any human health hazard. Although health concerns are usually generated from seafood taint, "tainting" is primarily a marketing concern regarding the salability of seafood. It is reasonable to conclude, with respect to oil spill contamination, that if seafood is not "tainted," it is acceptable for consumption. Seafood tainting panels can be established on a spill-specific basis by contacting the U.S. Food and Drug Administration. Additionally, the U.S. Coast Guard can close a particular "area of operation" to fishing and/or seafood harvest as a part of the emergency powers of an oil spill.

- **Public Health Concerns:** The occurrence of contamination in seafood organisms or products following an oil spill can lead to public health directives being involved because of the presence of known carcinogenic compounds in petroleum products. The aromatic fractions of oil contain the most toxic compounds, with polycyclic aromatic hydrocarbons (PAH) being of greatest concern. The California Department of Health Services (CDHS) should be contacted to determine chemicals of concerns as well as testing levels. Additionally, the CDHS can coordinate the closure and reopening of areas and fisheries for public health reasons.

- **Trustee Agency Concerns:** Many finfish, shellfish, mollusks, and crustaceans can become contaminated during an oil spill. Petroleum contamination of finfish and shellfish depends upon a variety of biological and ecological factors, including feeding strategies, habitat utilization, and physiology. The ecological and populations impacts of a spill will be species and habitat specific. The California Department of Fish and Game (CDFG) has the primary state trustee authority for these resources and can be contacted to determine if biological and ecological factors are a concern for a given resource. Additionally, the CDFG can close any fisheries under its jurisdiction for population health concerns.

Fishing is important in all maritime nations and many oil spills cause damage to subsistence, recreational and commercial fishing activity. Aquaculture enterprises have become widely established, thereby increasing the sensitivity of many coastal areas to oil pollution impact. Increased public awareness and heightened food quality and safety standards have meant that even small oil spills can cause a large impact and generate strong political interest.

Oil pollution effects take a variety of forms. Animals and plants may be killed as a result of oil smothering and toxicity. Catches and cultivated stock may become physically contaminated or acquire a taint. Fishing and cultivation gear may be oiled, leading to the risk of catches or stock becoming contaminated or fishing being halted until gear is cleaned or replaced. The handling of seafood products in bulk means that it is seldom practical to locate and remove the oiled specimens.

Fishermen and aquaculture operators are often in the front line of oil spill impact, but equipment suppliers, transporters, wholesalers and others are also involved in the process of bringing seafood produce to the market. Government authorities have a duty to protect public health and ensure that seafood products reaching the consumer are safe and palatable. A number of management strategies are available to prevent or minimize oil pollution impact on fishing and aquaculture activity. Fishing and harvesting restrictions can be imposed to prevent contamination of fishing gear and to protect consumers and markets. Such measures also provide time for evaluating risks and for organisms and their habitat to recover from oil contamination.

The purpose of this guidance is to identify the various problems that can arise and to describe the remedies available. The information is aimed primarily at those in the fisheries sector suffering economic loss as well as spill responders and managers with responsibilities for protecting public health, and consumers concerned about the safety and quality of seafood. Interested parties are encouraged to share experience gained in managing fishery resources during oil spills.

Oil spill impact on seafood resources

The impact of an oil spill on marine life depends largely on the physical and chemical characteristics of the oil and the way these change with time, a process known collectively as “weathering”. The main physical processes which act on the oil during the course of a spill are evaporation, natural dispersion and, to a lesser extent, sedimentation. Specific gravity, viscosity, chemical composition and toxicity of the pollutant and the way they change with time tend to determine the degree of oil exposure for seafood organisms. The prevailing weather and sea conditions will determine the movement of spilled oil. Clean-up activities such as the use of chemicals or aggressive washing techniques can also affect the fate of oil. Thus, a variety of factors combine to define the character of a particular oil spill and the fate of sensitive resources in its path.

Adult free-swimming fish, squid, shrimp and wild stocks of other commercially important marine animals and plants seldom suffer direct harm from oil spill exposure. This is because only rarely will oil concentrations in the water reach sufficient levels to cause tainting or mortality. The greatest impact is found on shorelines and shallow waters where animals and plants may be physically coated and smothered by oil or exposed directly to toxic components in the oil. Edible seaweeds and sea urchins are examples of shoreline species that are especially sensitive to smothering and oil toxicity, respectively.

Apart from direct effects, oil may cause more subtle longer-term damage to behavior, feeding growth, or reproductive functions. It is a complex task to isolate such sublethal pollution effects from the influence of numerous other factors.

Damage may also result from measures taken to combat an oil spill. Animals and plants which might normally be unaffected by floating oil can become tainted through exposure to oil droplets suspended in the water column if chemical dispersants are used unwisely. For this reason, as a general guide, dispersants should not be used close to aquaculture facilities or spawning grounds and nursery areas. Stripping oiled seaweed from rocks and indiscriminate hot water washing are further examples of aggressive techniques that can affect commercially exploited species and delay natural recovery.

Fishing and aquaculture activities

Oil can foul the boats and gear used for catching and cultivating commercial species. Flotation equipment, lift nets, cast nets, and fixed traps extending above the sea surface are more likely to become contaminated by floating oil, whereas lines, dredges, bottom trawls and the submerged parts of cultivation facilities are usually well protected, provided they are not lifted through an oily sea surface or affected by sunken oil.

Seaweeds, shellfish and cultivated animals kept in cages or tanks are usually unable to avoid contact with oil contaminants in the water and the presence of oil pollutants may significantly add to the stresses already imposed by keeping animals in artificial conditions. Floating oil may physically coat fish-farming facilities, and unless they are rapidly cleaned they may act as a longer-term source of stock re-contamination.

There are many complex influences on the health of cultivated organisms and observed effects may be the result of a combination of factors. If, for example, the stocking density or the water temperature in a fish farm is unusually high, there is a greater risk of mortality, disease or growth retardation occurring as a result of oil contamination.

The cultivation of seaweed, fish, crustaceans, mollusks, echinoderms and sea squirts frequently involves the use of onshore tanks to rear the young to marketable size, or to a size and age suitable for transfer to the sea. Such facilities are usually supplied with clean seawater drawn through intakes located below the low water mark. The intakes may occasionally be under threat from sunken oil or dispersed oil droplets, which may lead to contamination of pipework and tanks and the loss of cultivated stock.

Fishing and seafood cultivation are not always pursued throughout the year and seasonal differences in sensitivity to oil spills can therefore occur. The collection of wild seed, or the rearing of larvae in onshore tanks supplied with water piped from the sea is one example of seasonal activity.

Tainting

The contamination of seafood can usually be detected as a petroleum taste, or taint. Public confidence in seafood products can quickly erode as a result of suspect, or actually contaminated, products reaching the market. Filter-feeding animals such as bivalve mollusks are particularly vulnerable to tainting since they may easily ingest dispersed oil droplets and oiled particles suspended in the water column. Animals with a high fat content have a greater tendency to accumulate and retain petroleum hydrocarbons in their tissues.

A taint is commonly defined as an odor or flavor that is foreign to a food product. Background concentrations of oil in water, sediment and tissues are highly variable and both the degree of taint that may result and consumer tolerance levels for taint are different for different seafood products, communities and markets. The presence and persistence of taint will depend mainly on the type and fate of oil, the species affected, the extent of exposure, hydrographic conditions and temperature. Tainting of living tissue is reversible but, whereas the uptake of oil taint is frequently rapid, the depuration process whereby contaminants are metabolized and eliminated from the organism is slower.

The concentrations of hydrocarbons at which tainting occurs are very low. Some of the chemical components in crude oils and oil derivatives with the potential to cause tainting have been identified but many are unknown and no reliable threshold concentrations for petroleum-derived tainting agents have been established. Hence it is not possible to determine by chemical analysis alone whether a product is tainted or not. However, the presence or absence of taint can be determined quickly and reliably by sensory testing, when a trained panel and sound testing protocols are employed. Sensory testing is further described below.

Public health concerns

The occurrence of contamination in seafood organisms or products following a major spill has potentially damaging implications for marketing and can lead to public health directives being invoked because of the presence of known carcinogenic compounds in petroleum products. The aromatic fractions of oil contain the most toxic compounds, and among these it is the 3- to 7-ring polycyclic aromatic hydrocarbons (PAH) that command greatest attention.

The input of potentially carcinogenic PAH stems largely from combustion sources and petroleum and, for the human population, exposure to PAH is primarily from food. However, in common with other potentially carcinogenic pollutants, it is not possible to define a concentration threshold of potential carcinogens in seafood products that represents a risk-free intake for humans. Furthermore, a wide variety of smoked food, leafy vegetables and other dietary components also contain the same PAH compounds. The detailed composition of the diet determines which food items are major contributors for individual consumers. It is important to recognize that different regions and ethnic groups have varying levels of seafood in their diets.

Generally, PAH levels in foods are not subject to legislative limits, although limits exist for some compounds in drinking water. The risk to an individual or community from oil spill-derived carcinogens should be assessed in the context of the overall exposure from all potential sources, which is subject to many variables. From a general risk evaluation of the amount, frequency and duration of PAH exposure following oil spills, most studies have led to the conclusion that oil spill-derived PAH contamination of seafood is not a significant threat to public health. However, it is important to note that while toxicologists have assessed the threat to public health as negligible, it may be difficult to convince local users, fish buyers and consumers in general, especially when there is an option of buying seafood from other locations.

A further complication for food safety and quality controllers is that a seafood diet is inherently nutritious and rich in protein and vitamins. Restrictions on seafood intake can cause consumption patterns to shift toward less healthy diets. Other forms of contamination, such as heavy metals, algal toxins, pathogenic bacteria and viruses, also affect seafood safety and quality. The potential impact of an oil spill on public health must be viewed in a wider context in order to identify and implement appropriate strategies.

Oil spill protection and clean-up response options

Booms and other physical barriers can sometimes be used to protect fixed fishing gear and aquaculture facilities, although in most cases it is impossible to prevent damage altogether. Fishing and cultivating equipment is often purposely sited to benefit from migration routes or efficient water exchange. Such locations are characterized by fast water flow, which is where booms will not perform well.

Sorbent materials are often useful for removing oil sheens from water and tank surfaces. Sorbent booms are easy to deploy and move, and serve to control sheens in floating cultivation pens. However, oil-saturated sorbents should be replaced regularly to avoid them becoming a source of secondary pollution. Another potential concern when dealing with aquaculture facilities is the risk of spreading disease with booms and other equipment moved from one location to another.

Dispersant should be used with care so as not to cause tainting of shellfish and captured or cultivated stock. As a general guide, it is not prudent to use dispersant in shallow waters where fishing or aquaculture is important. However, if used at a safe distance, dispersants can reduce or prevent contamination of equipment by floating oil. It is difficult to define in general terms what represents a safe distance since this will depend on dilution rates and the strength and direction of prevailing currents.

The remedial methods employed should be chosen with care, so as not to make matters worse. Almost all clean-up techniques cause damage, which should be taken into account when considering the merits of removing oil pollution from an affected area. For example, attempts at cleaning intertidal mudflats can cause long-term disruption and damage to the habitat of cockles and clams. There are occasions when it is better to rely on natural recovery processes for oiled habitats than to inflict more damage from clean-up measures known to be futile.

Sensory testing

Oil-tainted food is unpalatable even at very low levels of contamination, which provides a safety margin in terms of public health. As a generalization, if seafood is taint-free, it is safe to eat. Properly conducted sensory testing is the most efficient and appropriate method for establishing the presence and disappearance of tainting, and for indicating whether seafood is fit for human consumption. The International Standards Organization (ISO) provides information on the training of sensory evaluation panels. A trained sensory panel using properly prepared samples and a written testing protocols are essential elements in sensory testing in order to obtain reproducible results. In some cases of potentially unsafe seafood it may be appropriate to avoid taste tests and instead focus on olfactory testing.

A sampling program with defined objectives will often be necessary to determine the degree, spatial extent and duration of the oil contamination problem. The aim is to take and analyze the number of samples necessary to obtain statistically reliable results. Target species are those of commercial, recreational or subsistence fishing value and which are commonly consumed. Samples of animal and plant tissue are perishable and must be secured and stored so as to preserve their integrity. Control samples from a nearby area unaffected by oil pollution are important for reference purposes and to eliminate the interference of background contamination, but are difficult to find in practice. In the case of commercial species it is sometimes possible to obtain reference samples from the marketplace. If appropriate reference samples cannot be obtained, a trained panel of expert testers should nevertheless be able to determine when seafood is taint-free.

In principle, a relatively small number of samples are sufficient to confirm the initial presence of taint and define the affected area in order to introduce a restriction. Monitoring the progressive loss of taint, by sampling at appropriate intervals thereafter, allows the point at which taint disappears to be determined with some confidence. The oil type would determine the frequency of sampling, the habitat and organisms affected, and the rate at which depuration was observed to occur. A time series of samples gives clues to depuration rates and allows future trends to be predicted. While it is not an absolute requirement to have reference samples in order to conduct a sensory evaluation, the taint-free threshold can best be defined as the point where a representative number of samples from the polluted area are no more tainted than an equal number of samples from a nearby area or commercial outlet outside the spill zone. Account should also be taken of levels considered acceptable in comparable seafood species being harvested in other areas of the country.

This approach is inherently fair and recognizes that tainted samples, not necessarily due to oil spills, can occur in any population. Once two successive sample sets over a short period of time remain clear, restrictions can be removed or the scope of the ban adjusted as a distinct area or species is shown to be free of taint. The confidence in accepting that the fish or shellfish are clean and safe following a particular spill comes from an adequate time-series of monitoring data showing the progressive reduction in taint.

Chemical analysis

In some cases, the chemical composition and the fate of the spilled oil, widespread subsistence fishing and aquaculture, or the presence of commercial shellfish resources in the path of the oil may argue for chemical analysis to be undertaken. Chemical screening for exposure can complement sensory evaluations and help validate sensory testing. Sensory evaluation does not preclude the need for chemical analysis and may serve as a screening tool for selecting samples for further chemical analysis.

It is widely recognized that to impose a single fixed standard for PAH levels in seafood by reference to baseline data is unworkable for several reasons. Baseline data are rarely available and unlikely ever to be applicable to the conditions prevailing during a particular oil spill. Background levels of hydrocarbons, where they are known, vary greatly and are subject to both pyrogenic and chronic anthropogenic input. PAH intakes in seafood meals also vary greatly between different communities, as do the perceived sensitivities of individual consumers. One viable approach is to ensure that samples should be taint-free. PAH levels in the samples may also be compared to reference samples collected just outside the affected zone or which are freely marketed elsewhere in the country. However, this may be difficult to implement in areas that are known for their "pristine" seafood.

Analysis of water and sediment is usually not necessary since the condition of seafood organisms inhabiting water and sediment environments is of primary interest. In any case, the organisms effectively “monitor” the condition of their surrounding environment by the process of accumulating and depurating contaminants, and if they remain viable then there is little need to monitor other components. In cases where animals or plants are continuously re-contaminated from an invisible or unknown source it may be appropriate to attempt to monitor the pathway of oil contamination. However, reliable interpretation of analytical data from sediment samples can be difficult if there is a wide range of other contaminants present.

Costs and compensation

When it proves impossible to protect fishing gear and cultivation facilities from oil contamination, the choice becomes one of cleaning, repairing, restoring or replacing the affected item, facility or habitat.
In some situations compensation arrangements may exist, allowing fishermen and aquaculture operators to be reimbursed for costs incurred and losses suffered. Claimants will be expected to provide evidence of the losses, such as receipts of payments made and records of income in previous years.

The complexities of biological systems and business interactions often make it difficult to separate the actual impact of an oil spill from other influences. Reliable catch statistics are rarely available in sufficient detail to enable oil spill effects to be isolated from other influences such as variable fishing effort and natural fluctuations in the stock. Only with expert knowledge of local circumstances, careful investigation and comparisons with nearby unpolluted areas can the true causes of observed damage be determined. In the case of subsistence fishing no financial transactions may be involved, so catch records are unlikely to be available. However, it should be possible to quantify subsistence loss in bartering terms or with other market-based substitutes.

Economic loss resulting from mortality of cultivated organisms may need to be quantified at several levels. The first level is the immediate mortality and loss suffered by the grower. This may simply be a question of counting and weighing the casualties, documenting any reduction in growth rate, and calculating any financial losses from projected harvests and from closed or under-utilized aquaculture facilities. Depending on the magnitude of the event and the availability of suitable substitutes, losses may also be suffered by processors, transporters, wholesalers and retailers. In a large or notorious incident actual or perceived tainting may result in short and long-term loss of markets and reduced prices across broad geographic regions. Quantification of these impacts can be complicated and may involve not only the direct losses, but also the advertising costs incurred to limit the harm to a region's reputation.

Management strategies for protecting seafood resources

The simplest management strategies involve no intervention beyond monitoring the evolution of an oil spill and any threat to seafood safety. Low-key intervention can take the form of advisory information or the issuing of guidelines to the seafood industry. Stricter measures include retail controls, impoundment of catches and seafood products, activity bans and fishery closures.

All management options have drawbacks or indirect effects and a careful review of the various facets of an oil spill is to be recommended before any actions are taken. Commercial fishing creates complex changes in the abundance and distribution of the exploited species. Any sudden change in the fishing effort is therefore likely to affect population densities. Thus, while most oil spill management strategies undoubtedly cause business interruption and financial loss, some fishery closures have also resulted in beneficial stock conservation, particularly where the exploited species have been non-migratory.

Preferred management strategies reflect cultural and administrative traits in different countries. In Asia there are few reported instances of tainting or seafood contamination following oil spills. Formal closures or activity bans are seldom, if ever, introduced. Instead voluntary suspension of fishing in oil-polluted areas is the norm. The voluntary suspension typically lasts a few weeks until the gross oil contamination of shorelines has disappeared or has been removed. In most cases, fishing and harvesting are resumed without any ill effects in terms of tainting, public health or market confidence.

During an oil spill it is vital to communicate information to the media and the public in an effective manner on the likelihood of adverse consequences for fishery resources. Inaccurate public information about tainting and contamination may limit the range of management strategies available, causing unnecessary fishing and harvesting restrictions and/or loss of consumer confidence in the market. Risk communication is an ongoing process that must be addressed in both spill response planning as well as during the spill event. Information about risk can be communicated through a variety of channels, from media reports to public meetings. Several resources provided in Appendix F can provide further information on successfully communicating risk to the media and public.

The media can play a valuable role in promoting a rational reaction to temporary disruptions. For example, where a properly conducted sampling and testing regime provides clear evidence that seafood is safe, the media provides the vehicle for getting this message to the consumer. The needs of the media are best served by providing factual information and by clearly justified decisions. Contingency planning provides the best opportunity for managers to select an appropriate strategy and implement the most effective response for dealing with a threat to seafood safety and quality.

Fishing and aquaculture procedures

In addition to standard spill response measures, there are management options that may help minimize contamination and financial losses. Options include moving floating facilities out of the path of slicks, sinking of specially designed cages to allow oil to pass, and transfer of stock to areas unlikely to be affected. The opportunities to use these approaches are likely to be rare for a range of technical, logistical and cost considerations, but in the right circumstances and with planning they may be practicable.

Temporarily suspending the replenishment of seawater drawn in from the sea and re-circulating water already within the system may be an effective method of isolating stock cultivated in shore tanks or ponds from the threat of oil contamination. Closing sluice gates to prawn ponds, for example, can also afford short-term protection, but care must be taken to ensure that the build-up of noxious waste products in stagnant or re-circulating water over time does not cause mortalities. Suspension of feeding is another way of reducing the risk to farmed fish and other cultivated stock from coming into contact with floating oil or contaminated feed. In land-based facilities the reduction or suspension of feeding has the advantage that the loading of waste products in the re-circulated water is reduced.

For such measures to be effective it is vital that sensitive fishing and aquaculture facilities are identified in local area contingency plans and that key personnel are notified in the event of an oil spill in their area. The plans can also identify optimal response options and the sources of necessary materials and equipment. The preparation and maintenance of such plans are normally the responsibility of local government authorities or operators of local oil-handling facilities.

In some cases aquaculture operators may face the risk of ultimately losing all the stock due to oil spill damage. Harvesting before the stock becomes oiled might be possible, albeit selling the products at a lower price, and thereby salvaging some of its value. Conversely, normal harvesting could be delayed to allow contaminated stock to depurate and become taint-free.

Where fish are caught by anglers for sport, sufficient protection can sometimes be provided simply by issuing advice against consuming the catch and for recreational fishermen to adopt a catch-and-release policy.

Fishing and harvesting restrictions

Government restrictions on fishing activity are often unrelated to oil spills and are imposed as a means of stock conservation or to ensure fair competition among fishermen. Fishing may be restricted to certain periods and locations, with closures often coinciding with breeding seasons and sites to encourage natural stock replenishment. Catches may be restricted to certain quantities or quotas in a given period. Temporary closures of fisheries are imposed to protect consumers from health hazards when water and sediment quality or a seafood resource has become degraded by pollutants, natural toxicants or microorganisms.

Fishery closures can be imposed after an oil spill in order to prevent or minimize fishing gear contamination and to protect or reassure seafood consumers. Fishermen can agree to a voluntary suspension of fishing activity as a precautionary measure during a period when oil is drifting in their normal fishing area, and thereby avoid repeatedly contaminating fishing gear. Alternatively, a fishery may be protected by extending existing closures or imposing additional bans, but there are likely to be secondary consequences from all these measures.

Fishery closures imposed to protect equipment and catches can generally be lifted once the sea surface is visually free of oil and sheen, and there is no problem with sunken oil. Aerial surveillance is the most reliable way of checking sea surface conditions. Restrictions imposed on the basis of proven tainting are likely to be more prolonged and require careful monitoring. In most oil spill scenarios a fisheries and aquaculture management protocol consisting of a visible-sheen test and sensory tests will satisfy the demand for scientific credibility and provide adequate safeguards against unpalatable and unsafe seafood reaching consumers.

Credible decision-making with respect to fishing and harvesting restrictions should be based on sound scientific principles and common sense. Knowledge of fishery resource management is essential, as is an understanding of oil pollutants, their physical and chemical characteristics, likely biological impact, and background levels of contamination, both locally and nationally. Seafood consumption patterns and seasonal variations in trading and marketing will further help define a public health risk profile and allow regulators to form a considered opinion on risk management. It is vital to determine the criteria that will be applied for reopening a fishery before a ban is put in place. These criteria form an important part of contingency plans. It is also critical to assess the benefits accruing as a result of a closure against the losses that will ensue from closing or restricting normal fishing and cultivation activity.

Conclusions and recommendations

Oil spills can pose a significant threat to fishing and aquaculture resources. The main oil pollution effects are physical contamination of equipment, tainting and contamination of seafood, and economic loss from business interruption, including loss of consumer confidence. With effective contingency plans and spill response procedures, much can be done to prevent or reduce the impact of oil spills on fishing and aquaculture.

The repercussions of contaminated seafood on public perception can be serious unless the issues of market confidence and public health are properly managed. In most cases a management protocol consisting of a visible-sheen test coupled with sensory testing will provide adequate safeguards against unpalatable and unsafe seafood reaching consumers.

To maintain confidence in the fisheries sector there should be a sound strategy for implementing a fishery closure, based on scientific data, and a consistent application of management restrictions. An important component of oil spill contingency considerations is the need to determine re-opening criteria before deciding on whether to impose fishing and harvesting bans. Part of the rationale for introducing fishery closures is to minimize or prevent economic damage that might otherwise occur, as well as protecting the consumer. In such cases some form of economic appraisal is necessary in order to monitor the effectiveness of control measures from a cost-benefit viewpoint.

G.2 Decision Process for Managing Seafood Safety

The default position regarding management of seafood safety during an oil spill is to have no closure or other restrictions on seafood harvest. In some cases there may be an initial, temporary *de facto* closure if the U.S. Coast Guard establishes a safety zone restricting access in areas of active oil recovery. Fishermen also may voluntarily avoid working in oiled areas to prevent oiling their gear and catch. This initial period after a spill can provide an opportunity to evaluate spill conditions and conduct limited testing to determine whether a precautionary closure or other immediate restrictions on seafood harvest are warranted.

The first step for seafood managers after an oil spill has occurred is to collect and evaluate information on the nature of the spill. The spill response organization should be able to provide the following information almost immediately after the spill occurs:

- Overflight maps and trajectory analyses showing the present and predicted spread of surface slicks;
- Forecasts of weather and sea conditions that may affect the potential for oil to mix into the water column;
- Results of oil weathering models;
- Details about the oil type and expected behavior;
- Predictions of oil fate and persistence; and, some cases,
- Chemical results for water and sediment samples collected in the spill area.

Fishery management agencies and associations should be able to provide information on:

- Species being harvested now or in the near future;
- Geographical extent of the harvest areas;
- Harvest gear types in use; and,
- Data on background levels of PAH contamination in the spill area (from NOAA, California State Mussel Watch, and other monitoring programs).

Based on this information, seafood managers can assess whether the oil spill is likely to expose and contaminate seafood. If seafood is not at significant risk, then no harvest closures or other seafood restrictions are needed, and this determination is communicated to the public. Because spills are dynamic, conditions are monitored and risks to seafood reevaluated until the threat abates.

If managers determine that seafood may be affected, the next step is to assess whether seafood is tainted or contaminated to levels that pose a consumption risk to human health. Information that can help determine the impacts includes:

- Overflights and ground surveys identifying visible oil in seafood harvesting areas;
- Chemical analysis of water and/or sediment samples from the harvest area;
- Sensory testing of seafood samples from representative species and areas (both spill and reference areas);
- Chemical analysis of tissue samples from representative species and areas (both spill and reference areas); and,
- Data on background levels of oil-related contaminants.

Determining whether seafood has been contaminated can take time. Developing and implementing sampling plans, conducting sensory and/or chemical testing, and evaluating results may require weeks or longer. Monitoring continues and the risk assessment process is repeated as necessary.

If seafood is tainted or is contaminated to a level posing a potential health risk, the next step is to select the most appropriate seafood management action(s). Examples of management actions include seafood advisories, increased inspections of harvested seafood or fishing gear, harvest closures, and fishing gear restrictions. If a fishery is closed or otherwise restricted, seafood managers must establish criteria for determining when the seafood is palatable and safe for human consumption and that restrictions can, therefore, be lifted. No accepted international or federal criteria have been established for oil-related contaminants in seafood. State seafood managers generally have developed their own criteria for each spill, resulting in some inconsistencies among spills. Varying levels of background contamination also have contributed to inconsistencies in criteria applied.

Seafood Safety Management Authority

Typically, authority to manage seafood to protect human health resides with state health agencies. Many states routinely chemically analyze finfish and shellfish tissues for contamination as part of their water-quality monitoring programs. If a state concludes that eating contaminated finfish or shellfish collected from state waters poses an unacceptable human health risk, it may issue local fish consumption advisories or harvest closures for specific water bodies or parts of water bodies and specific species.

The Food, Drug, and Cosmetic Act authorizes the U.S. Food and Drug Administration (USFDA) to protect and promote public health. The USFDA's responsibilities include keeping "adulterated" food off the market. The USFDA has jurisdiction over seafood that crosses state lines in interstate commerce.

The Magnuson Act, 16 U.S.C. 1801 *et seq.*, authorizes NOAA's National Marine Fisheries Service (NMFS) to regulate fishing in federal waters (generally from 3-200 miles from shore). The act is targeted toward fishery conservation rather than protection of public health or economic concerns. Fishery management plans, developed under the authority of the Magnuson Act, specify any limitations imposed on fishing for federally regulated species. Limits on fishing are enforced by means of regulations published in the Federal Register, in compliance with the Administrative Procedures Act. In the event of an oil or chemical spill, publication of an emergency rule in the Federal Register is required to put an enforceable, official fishery closure in place and to make any modifications to the closure once it is put into effect. The Magnuson Act was recently amended to allow emergency action fisheries closures to remain in effect indefinitely. Previously, such closures were limited to two 90-day periods.

Specific Seafood Contamination Terminology

Adulteration

According to the U.S. Food and Drug Administration (FDA), a food is considered adulterated if it bears or contains any poisonous or deleterious substance that may render it injurious to health, if it contains any filthy, putrid, or decomposed substances, or if it is otherwise unfit for food (Federal Food, Drug, and Cosmetic Act, Section 402).

Taint

Taint is commonly defined as an odor or flavor that is foreign to a food product, including seafood (ISO 1992). According to this definition, the presence of a taint simply indicates that flavor or odor is altered; it does not characterize the nature of the off-flavor or off-odor, quantify the degree of taint, or imply health hazard.

Body Burden

The concentration of a contaminant in an organism, reported for the whole animal, or for individual tissues such as gonads, muscle, and liver, is referred to as the body burden. It can be reported on the basis of either wet or dry weight of the organism or tissue.

Uptake

Uptake is the process of contaminant accumulation in an organism. Uptake of oil can occur via the following mechanisms:

- Adsorption (adhesion) of oil on the skin.
- Absorption of dissolved components from the water through the skin (including interstitial water exposures for infauna).
- Absorption of dissolved components through the gills.
- Adsorption of dispersed oil droplets to the lipid surfaces in the gills.
- Ingestion of whole oil droplets directly or of food contaminated with oil, followed by sorption in the gut.

Many factors influence uptake, including the exposure concentration and duration, pathway of exposure, lipid content, and feeding and metabolic rates. Uptake from water generally occurs more quickly than dietary uptake or uptake from sediments.

Bioaccumulation

The net accumulation of a substance by an organism as a result of uptake from all environmental sources and possible routes of exposure (contact, respiration, ingestion, etc.) is termed bioaccumulation.

Bioconcentration

The net accumulation of a substance as a result of uptake directly from aqueous solution.

Biomagnification

The increase in body burden of a contaminant with trophic level is called biomagnification. PAHs generally do not biomagnify in finfish and shellfish because of their low dietary uptake efficiencies, on the order of 1 to 30%, reflecting slow kinetics and short residence time in the gut.

Elimination

All of the processes that can decrease tissue concentrations of a contaminant, including metabolism, excretion, and diffusive loss are collectively termed elimination. *Metabolism* is an active physiological process whereby a contaminant is biotransformed into metabolites. For PAHs, the metabolites are more water-soluble, which facilitates *excretion*, another active physiological process that eliminates contaminants (both parent compounds and metabolites) through bile, urine, or feces. *Diffusive loss* refers to a decrease in tissue burden caused by simple diffusion out of the organism, which is controlled by partitioning between tissue and water. The term *depuration* may be used for the mechanism of diffusive loss, and *elimination* may be used for the combined process of metabolism, excretion, and diffusive loss. These definitions are slightly different than those used by ASTM (1994), which defines depuration as “the loss of a substance from an organism as a result of any active or passive process” and provides no definition for elimination. However, the definitions given are more precise and will be followed in this document. Elimination can also include release of PAHs in lipid-rich eggs or gametes during spawning.

Elimination processes begin as soon as uptake occurs. In constant exposure experiments, body burdens tend to reach a “steady state” in which fluxes of the contaminant moving bi-directionally across a membrane or boundary between compartments or phases have reached a balance, not necessarily equilibrium. When the exposure decreases, elimination rates depend, in part, on the hydrophobic properties of the compound. The half-lives of individual compounds vary (see discussion below).

Growth Dilution

Growth dilution occurs when the rate of tissue growth exceeds the rate of accumulation, such that it appears as though elimination is occurring because the tissue concentration is decreasing. This process may be important when monitoring bivalves during the growing season.

Oils have been grouped into types with similar properties to help predict their behavior at spills. This same approach can be used to characterize the relative risk of contamination of seafood by oil type. Table II-2 summarizes the properties and risk of seafood contamination for the five oil groups commonly encountered by spill responders. These generalizations can be used when initially screening an incident to evaluate the potential for seafood contamination.

ASSESSING THE LIKELIHOOD OF SEAFOOD EXPOSURE AND CONTAMINATION

Each oil spill is a unique combination of conditions and events. Seafood is only at risk of contamination from a spill if it is exposed to the oil. Once exposed to oil, an organism becomes contaminated only to the extent it takes up and retains petroleum compounds. Factors that influence the potential for spilled oil to expose and contaminate seafood are discussed in this section.

Oil Types and Properties

Oil type and properties strongly influence whether seafood is exposed and contaminated. Crude oils and the refined products derived from them are complex and variable mixtures of hydrocarbons of different molecular weights and structures. They can contain hundreds of different compounds. All crude oils contain lighter fractions similar to gasoline, as well as heavier tar or wax fractions. Because of these differences in composition, different oils vary considerably in their physical and chemical properties. For example, consistencies of different crude oils vary, ranging from a light volatile fluid to a viscous semi-solid. Such differences in properties influence behavior of spilled oil and subsequent cleanup operations.

The petroleum hydrocarbons that comprise oil are composed primarily of hydrogen and carbon, but also can contain varying amounts of sulfur, nitrogen, oxygen, and trace metals. The three main fractions of hydrocarbon compounds in oils are saturates, aromatics, and polar compounds. The table below shows the properties and relative abundance of each fraction in different types of oil products.

Seafood contamination can result from exposure to the dissolved fraction of oil, dispersed oil droplets, or an oil coating. With regard to the dissolved fraction, the aromatic fraction of the oil poses the greatest exposure risk because aromatics are relatively more soluble than the other components in oil. Saturates are a major component of oil, but they have lower solubility and higher volatility compared to aromatics of the same molecular weight. Furthermore, saturates are virtually odorless and tasteless, and do not contribute to tainting.

Table G.2-1 Characteristics of oil types affecting the potential for seafood contamination

Gasoline products	Diesel-like products and light crude oils	Medium-grade crude oils and intermediate products	Heavy crude oils and residual products	Non-floating oils
Examples – Gasoline	Examples – No. 2 fuel oil, jet fuels, kerosene, West Texas crude, Alberta crude	Examples – North Slope crude, South Louisiana crude, IFO 180, lube oils	Examples – San Joaquin Valley crude, Venezuelan crude, No. 6 fuel oil	Examples – Very heavy No. 6 fuel oil, residual oils, vacuum bottoms, heavy slurry oils
Specific gravity of < 0.80 Floats on surface	Specific gravity of < 0.85; API gravity of 35-45* Usually floats on surfaces, although can contaminate suspended sediments that are then deposited on the bottom.	Specific gravity of 0.85-0.95; API gravity of 17.5 – 35 * Usually floats on surface, although can mix with sand by stranding on beaches or in the surf zone, and be deposited in the nearshore area.	Specific gravity of 0.95 – 1.00; API gravity of 10-17.5 * Usually floats on surface but can sink in fresh water or in seawater if they emulsify or mix with sand (in the surf zone or after stranding on beaches) and deposit in the nearshore.	Specific gravity greater than 1.00; API gravity < 10 * Will sink in fresh water; may sink in seawater if they emulsify or mix with sand (in the surf zone or after standing on beaches) and deposit in the nearshore.
High evaporation rates; narrow cut fraction with no residues.	Refined products can evaporate to no residue; crude oils do leave residues.	Up to one-third will evaporate in the first 24 hours; will form persistent residues.	Very little product loss by evaporation; will form persistent residues.	Very little evaporation when submerged; also very slow weathering overall when submerged.
Low viscosity; spreads rapidly to a thin sheen; readi8ly dispersed; will not emulsify.	Low to moderate viscosity; spread rapidly into thin slicks; readily dispersed by natural processes; may form unstable emulsions.	Moderate to high viscosity; dispersed by natural processes only very early in the spill; readily emulsifies.	Very viscous to semisolid; will not readily disperse or mix into the water column; can form stable emulsions.	Very viscous to semi-solid; will not readily disperse or mix into the water column; can form stable emulsions.
Low risk of seafood contamination because of rapid and complete loss via evaporation; potential contamination for spills in confined areas with high mixing, such as small rivers; no reported cases of tainting for marine spills.	Moderate to high risk of seafood contamination because relatively high content of low molecular weight, water-soluble aromatic hydrocarbons, which are semi-volatile and so evaporate slowly; dispersed droplets are also bio-available.	Moderate to high risk of seafood contamination because of high percentage of low-molecular weight aromatic hydrocarbons; coating of gear and intertidal species can be significant.	Low risk of finfish contamination because of low water-soluble fraction and little natural mixing in the water; moderate to high risk of shellfish contamination where shoreline oiling is heavy; can coat gear and intertidal species.	Low risk of finfish contamination because of high viscosity; where thick oil accumulates on the bottom, could become a chronic source; moderate to high risk of contamination of benthic species because of coating and persistence of submerged oil.

* API gravity is used by the petroleum industry rather than density. It is determined by the following equation: API at 60º F = 141.5/oil density – 131.5

Of the aromatic hydrocarbons, the mono-aromatic hydrocarbons, such as benzene, toluene, ethyl benzene, xylene (known collectively as BTEX), other substituted benzenes, and the 2- to 3-ringed PAHs (naphthalene, fluorene, dibenzothiophene, anthracene and their substituted homologues, referred to as low-molecular weight PAHs) comprise over 99 percent of the water-soluble fraction. The distribution of these compounds in the spilled oil is one measure of the potential for contamination of seafood from water exposure.

Compounds in petroleum-derived oils have a general pattern of increasing abundance with higher level of substitution of a benzene ring (*e.g.*, unsubstituted parent naphthalene is less abundant than C1-naphthalene, which is less abundant than C2-naphthalene). This pattern indicates that the PAHs are “petrogenic,” that is, they are from petroleum oils. The PAH pattern is very different for hydrocarbons produced from the combustion of fossil fuels (“pyrogenic” hydrocarbons), in that the parent PAHs are by far the dominant compounds in hydrocarbons of pyrogenic origin. Also, it is important to note that crude oils contain very low concentrations of the high-molecular weight PAHs (*e.g.*, 4- and 5-ringed compounds such as pyrene, chrysene, and benzo[a]pyrene) that are associated with combustion by-products. These differences in relative PAH abundance are key components of fingerprinting analysis.

Refined products have characteristic ranges of PAHs representative of the distillation fraction in the product. PAHs in No. 2 fuel oil are dominated by the 2- and 3-ringed compounds. Heavy fuel oils are sometimes cut or blended with lighter fractions to meet customer specifications, as is the case with the intermediate fuel oil (IFO-180), and so can contain some low-molecular weight PAHs.

For exposure via ingestion of whole oil droplets or contaminated sediments, the high-molecular weight PAHs pose greater risk of contamination. These compounds have low water solubility and are more lipophilic. In organisms with relatively limited capability to metabolize PAHs, such as bivalve mollusks, the high-molecular weight compounds are more likely to accumulate in tissues and persist for longer periods, compared to the low-molecular weight PAHs, which are more rapidly eliminated. Finfish and some crustaceans, however, readily metabolize and eliminate all of these compounds rapidly.

Biological and Ecological Factors Affecting PAH Contamination of Seafood

Petroleum contamination of finfish and shellfish depends upon a variety of biological and ecological factors. Understanding how different feeding strategies, habitat utilization, and physiology influence the likelihood of petroleum contamination of particular species is critical when managing seafood after spills. G.2-2 summarizes several of these factors for different types of seafood organisms.

Metabolic Capacity

Both vertebrates and invertebrates have mixed-function oxygenase (MFO) enzyme systems that enable them to metabolize petroleum substances. Enzymatic activity is low in invertebrates compared to vertebrates, and therefore induction of metabolism occurs at a higher contamination level in invertebrates. Finfish are able to rapidly and efficiently biotransform or metabolize PAHs and excrete the resulting metabolites into bile. These metabolites do not pose a health risk to human consumers of the finfish. Marine invertebrates, including most shellfish, metabolize petroleum compounds slowly and inefficiently; consequently, they tend to accumulate high concentrations and wide ranges of PAHs.

Metabolic capacity of organisms is important from a seafood safety standpoint because some PAHs have carcinogenic potential for human consumers, due to the highly chemically reactive oxidation products that form during the first stage of metabolism in vertebrates. Human consumers often eat invertebrates in their entirety, and, therefore, may ingest all of the hydrocarbons that have accumulated in the organism and may be present in the organism’s gut. Because finfish, like other vertebrates, rapidly and efficiently metabolize petroleum hydrocarbons, they generally pose little or no health risk to human consumers. Exceptions to this may occur for consumers for whom the edible portion of finfish includes tissues such as liver and gall bladder, which tend to accumulate higher levels of PAHs than muscle tissue.

Temperature

It is generally accepted that uptake and elimination rates both tend to increase with increasing temperature, though there is some contradiction among reported study results for PAHs.

The rate of reaction in chemical and biological processes generally increases 2- to 4-fold for a 10°C increase in temperature. Uptake, metabolic, and elimination rates typically increase with temperature, but at different rates, making it difficult to predict body burdens under the constantly changing oil concentrations that occur at spills. However, at high temperatures and increased respiration and filtration rates, it is expected that uptake will occur quickly, to relatively high concentration, followed by rapid declines. At low temperatures, body burdens are likely to be lower, but elimination rates will also be slower. At very low temperatures, some species stop feeding and thus are at lower risk of exposure.

Table G.2-2 Habitat utilization, feeding strategies, and risk of exposure to oil of different seafood groups.

Seafood groups	Examples	Metabolic capacity	Habitat utilization	Feeding strategies	Risk of exposure
Finfish					
Anadromous fish	Sturgeon, herring, salmon	High capacity	Nearshore and shallow water during spawning	Predatory	Moderate to high in nearshore and shallow water during spawning
Marine pelagic and bottom fish	Mackerel, jacks, cod, flounder	High capacity	Highly mobile, most species prefer depths of > 10m	Predatory	Low
Reef fish	Sea basses, snappers, porgies	High capacity	Relatively deep waters (10 – 200 m)	Predatory	Low to moderate; higher risk in shallow water
Estuarine fish	Bluefish, mullet, anchovies	High capacity	Spawning in intertidal or subtidal habitats; offshore winter migrations	Predatory	Moderate to high in nearshore and shallow water during spawning
Crustaceans					
Lobster, crabs, shrimp	American lobster, pink shrimp, blue crab	Reduced capacity	May migrate seasonally; range of depths between estuarine and deep waters.	Predatory; omnivorous, scavengers	Benthic burrowing, estuarine and shallow water species at higher risk than deep water species
Mollusks					
Oysters, mussels	American oyster, Pacific oyster, blue mussel	Very limited capacity	Shallow subtidal and intertidal regions, estuaries; attached to substrates	Filter-feeders	High
Clams, scallops	Hard clam, soft-shell clam, bay scallop, sea scallop	Very limited capacity	Intertidal and shallow subtidal areas; benthic or buried in the sediment; some mobility	Filter/deposit feeders	High
Gastropods	Abalone, conch, snails, whelk, limpet, top shell	Very limited capacity	Intertidal and shallow to deep subtidal areas; epibenthic; some mobility	Grazers and predatory	Moderate to high

Physiology

Lipid, carbohydrate, and protein levels are known to vary seasonally in certain aquatic invertebrate species, often associated with reproductive changes. Some of these changes in biochemical composition may affect uptake and elimination rates seasonally. Seasonal variation may also result from differences in feeding rates, microbial activity, and various environmental factors.

Organisms with higher overall lipid content generally exhibit higher levels of uptake or retention of petroleum compounds. For example, salmon (muscle lipid content of 4.0% wet weight) accumulated higher hydrocarbon concentrations than cod (muscle lipid content of 0.75% wet weight). Uptake rates of PAHs in clams peaked when gametogenesis was near completion and decreased during spawning, while elimination rates peaked during spawning. Oysters and clams sampled at the high point of lipid and glycogen reserves during their spawning cycles (the fall) had PAH tissue levels that were 2 to 3 times higher than they were when sampled during the spring. High elimination rates during the loss of lipid-rich eggs are consistent with findings that finfish and shellfish tend to accumulate PAHs in tissues with high lipid content because PAHs are strongly hydrophobic.

Potential variations in PAH uptake and elimination rates in seafood species due to seasonal and physiological variation should be taken into account during spill response. These differences should be considered when designing seafood sampling plans and when comparing analytical results from samples from different species, collected at different times of year, or collected during different stages in the life cycle of the organisms.

Chronic Exposure Stress

Bioaccumulation levels and elimination rates of hydrocarbons for finfish and shellfish may depend on the type and duration of exposure to petroleum products, and the extent to which the organisms have been chronically exposed to other contaminants. Chronic exposure appears to reduce elimination capacity. In fact, there may be two phases of elimination: an initial rapid phase followed by a second slower phase for PAHs that are sequestered in stable compartments of the organism, such as storage lipids. Some chronic hydrocarbon pollution studies have indicated no significant reductions in PAH levels in tissues over 2-4 months for clams and mussels, even when the animals were moved to cleaner habitats. The ratio of liver/muscle concentrations in finfish sometimes can be used as an indicator of the level of chronic PAH contamination at a site. Liver levels represent shorter-term exposure to oil, while muscle levels represent longer-term bioaccumulation. Therefore, lower liver/muscle ratios may indicate decreased efficiency in an organism's ability to biotransform absorbed or ingested oil into compounds that are easily excreted.

Other subsistence and recreational seafood organisms

Some organisms that are collected and consumed for subsistence and recreation were not discussed in this section. Examples are octopus, squid, seals, whales, seaweed, and algae. There isn't enough information on these organisms to thoroughly discuss the level of risk they may pose to consumers following an oil spill. It should be noted, however, that if these organisms occur in a spill area and are exposed, restrictions on harvest or consumption advisories might be warranted, depending on contamination and consumption levels.

Summary

- Wild finfish are unlikely to become contaminated or tainted because they typically are either not exposed or are exposed only briefly to the spilled oil and because they rapidly eliminate petroleum compounds taken up. Exceptions may occur if a large amount of fresh, light oil is mixed into the water column or if bottom sediments become contaminated. If nearshore sediments are contaminated, species that spawn in nearshore and shallow waters are more likely to be exposed to spilled oil than pelagic and benthic species.
- Penned finfish are more susceptible to tainting and contamination because they are not able to escape exposure.
- Shellfish are more likely than finfish to become contaminated from spilled oil because they are more vulnerable to exposure and less efficient at metabolizing petroleum compounds once exposed.

- Among crustaceans, species that burrow are at the highest risk of exposure at spills where bottom sediments are contaminated, followed by species that utilize nearshore and estuarine benthic habitats.
- Bivalves are at high risk of contamination because they are sessile, filter- and deposit- feed, and occur in substrates in shallow subtidal and intertidal areas that are more likely to become contaminated.
- It is generally accepted that uptake and elimination rates both increase with temperature, though study results are somewhat contradictory.
- PAHs tend to accumulate to higher concentrations in lipid-rich tissues and organisms. Sea-sonal differences in tissue lipid content associated with spawning may influence uptake and elimination rates of PAHs in some marine species.
- Chronic exposure to hydrocarbons in water and sediments may reduce elimination capacity.

MONITORING SEAFOOD FOR CONTAMINATION

The preceding section described information that can help determine the likelihood that spilled oil will expose and contaminate seafood. If it is decided that seafood is at significant risk, the next step is monitoring to determine whether seafood actually is contaminated, and to characterize the extent and degree of contamination. This section provides general guidelines for developing seafood sampling plans and conducting sensory and chemical testing of seafood samples for petroleum contamination.

Developing Seafood Sampling Plans

The first step in developing a sampling plan is defining the questions to be answered. Sampling should not begin before study objectives have been clearly established. Because every oil spill is a unique combination of conditions and the objectives of seafood sampling may vary from spill to spill, there is no standard sampling plan that can be applied to all seafood contamination monitoring studies. Generally, though, any sampling plan to monitor for potential seafood contamination from an oil spill should specify the study area, sampling locations, target species, number of samples to be collected, timing of initial and repeat sampling, sample collection methods and handling procedures, and analyses to be conducted. The statistical design must ensure sufficient statistical power to provide the information needed at the desired level of confidence to support seafood management decisions.

Some general guidelines for designing a seafood-sampling plan are presented below. For more detailed guidelines, see *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories Volume 1: Fish Sampling and Analysis* by the U.S. Environmental Protection Agency (2000). For more detailed sampling guidelines for sensory testing, see *Guidance on Sensory Testing and Monitoring of Seafood for Presence of Petroleum Taint Following an Oil Spill* (Reilly and York 2001).

Selecting sampling locations

In selecting sampling locations, all likely pathways of oil exposure should be identified (*e.g.*, surface slicks, dispersed or dissolved oil in the water column, submerged oil associated with bottom sediments), so that risks to specific fisheries can be evaluated. Inclusion of commercial, recreational, and subsistence harvest areas should be considered.

Collection of pre-exposure samples from the spill area or samples from appropriate unexposed reference areas is extremely important because they can provide information on background levels of contamination in the spill area. Petroleum hydrocarbons are ubiquitous in environmental samples, so we cannot assume that all petroleum hydrocarbons measured in a sample or all increases over time are a result of an oil spill. Furthermore, monitoring often continues until the level of contamination returns to “background.” Reference samples are key to determining the range of background concentrations and the baseline against which changes over time will be evaluated.

The best reference samples are pre-spill samples taken in areas not yet oiled but in the potential path of the oil ("before" can be compared with "after" exposure). If pre-spill sampling is not possible, unexposed reference sites comparable to exposed sites can be selected for sampling. However, site histories and differences in the characteristics of the sites should be carefully evaluated to determine whether there are significant differences between the exposed and reference areas. Often, areas that escape oiling do so because they differ fundamentally from exposed areas (for example, bays that face different directions), and so would not be expected to exhibit the same "background" conditions. Any differences between reference and exposed sites must be considered when analyzing and interpreting results.

National monitoring programs such as NOAA's National Mussel Watch Program can provide valuable pre-spill data for determining historical ranges of background concentrations of PAHs in shellfish at several locations around the country. When available for an area, PAH data from the NOAA Status and Trends Program (including the National Mussel Watch Program) or other monitoring programs may help determine normal background levels and seasonal patterns in contaminant levels.

Selecting target species to be sampled

Evaluating risk to human health from seafood consumption usually is a primary purpose of seafood sampling, so including species harvested commercially, recreationally, and for subsistence use may be important. Species that are present throughout the area of concern may be most appropriate for sampling if results are to be compared spatially or if the results are to be used to make statistical inferences to the entire area.

Hydrocarbon uptake and elimination rates vary widely. Finfish, for example, quickly metabolize and eliminate PAHs. Bivalves generally tend to bioaccumulate most contaminants and often serve as good indicators of the potential extent, degree, and persistence of contamination. On the other hand, some shellfish species stop feeding or passing water over their gills at extreme temperatures and, consequently, may exhibit low uptake rates under certain conditions. Consider such differences when selecting species for monitoring and comparing results among species.

Sampling frequency and duration

Monitoring generally should continue until contaminant levels reach background levels or predetermined acceptable levels. Periodic sampling before those levels are reached can reveal trends in contaminant levels. Appropriate monitoring frequency and duration will depend on spill conditions, such as oil type and volume spilled, flushing rates of affected water bodies, and the degree of exposure to wave action of contaminated shorelines. Appropriate monitoring frequency and duration will also depend on the species exposed and exposure duration. Finfish generally eliminate hydrocarbons within days or weeks, whereas bivalves may require several weeks or months. Elevated levels of petroleum compounds in bivalves have been detected for years at some sites where high levels of oil persist in adjacent sediments. Time of year should also be considered in some climates because elimination rates may be slower in cold temperatures. Other factors to consider with regard to monitoring frequency are the turnaround time for sample analysis and time required for the evaluation team to meet, interpret the results, and decide on the need for further sampling. Sampling plans may need to be adjusted over time as conditions change and as monitoring results provide new information on the fate of the oil and on which pathways of exposure are significant.

Sample collection and handling

The seafood-sampling plan should specify all details about sample collection. This includes the areas to be sampled, number of samples to be collected from an area (to meet statistical objectives), number of organisms or quantity of tissue to be composited (to meet analytical requirements), size of organisms to be collected, tidal elevations for collection (in the case of intertidal invertebrates), method of marking or recording exact sampling locations, and field notes to be recorded.

The sampling plan should also specify how seafood samples should be handled. This includes any field preparation, packaging and temperature requirements (for example, wrapping in foil, keeping in a cooler at 4°C or below, and freezing within a specified period of time), labeling, and any chain-of-custody requirements during transport to the analytical laboratory. The edible portion, which may vary culturally, is usually the portion of interest. Seafood samples collected for sensory testing generally should be handled as they would be during commercial, recreational, or subsistence harvest and transport.

Procedures should be followed to prevent cross-contamination in the field (such as preventing exposure of samples or sampling equipment to exhaust fumes and engine cooling systems on vessels) and to maintain the integrity of the samples. Likewise, good laboratory practices should be employed to prevent contamination of samples during preparation and analysis.

Testing Seafood for Contamination and Tainting

Generally, two different types of evaluations can be conducted after oil spills to determine whether seafood is contaminated. Sensory testing determines whether seafood is tainted, *i.e.*, if it has an off-odor or off-flavor. Chemical analysis determines whether tissues are contaminated with targeted compounds. Detailed methods of chemical analysis can indicate the presence as well as the quantity of specific contaminants in tissues. These results can be used to evaluate risk to human health through consumption of contaminated seafood. Summaries of these types of seafood testing are described below.

Sensory evaluation of seafood for presence of petroleum taint

When an oil spill occurs, local seafood resources may be exposed to petroleum compounds that affect their sensory qualities; that is, smell, taste, and appearance. Even when seafood from a spill area is considered acceptable with regard to food safety, flavor and odor may still be affected, negatively impacting the seafood's palatability, marketability, and economic value. Furthermore, tainted seafood is considered by the U.S. Food and Drug Administration to be adulterated and, therefore, is restricted from trade in interstate commerce.

Tainted seafood is defined as containing abnormal odor or flavor not typical of the seafood itself (ISO 1992). Under this definition, the odor or flavor is introduced into the seafood from external sources and excludes any natural by-products from deterioration due to aging during storage, decomposition of fats, proteins, or other components, or due to microbial contamination normally found in seafood. Taint is detected through sensory evaluation, which has been defined as "the scientific discipline used to evoke, measure, analyze and interpret those reactions to characteristics of foods and materials as perceived through the senses of sight, smell, taste, touch and hearing" (Food Technology Sensory Evaluation Division 1981). Humans have relied for centuries on the complex sensations that result from the interaction of our senses to evaluate quality of food, water, and other materials. In more recent times, sensory testing has developed into a formalized, structured, and codified methodology for characterizing and evaluating food, beverages, cosmetics, perfumes, and other commercial products. Sensory evaluation techniques are routinely used commercially in quality control, product development, and research. Sensory testing can be either subjective or objective. Subjective testing measures feelings and biases toward a product rather than the product's attributes. For objective testing, highly trained assessors use the senses to measure product attributes. Testing of seafood for petroleum taint should be completely objective and should be conducted by highly trained analysts.

Objective sensory testing serves as a practical, reliable, and sensitive method for assessing seafood quality. Only human testers can measure most sensory characteristics of food practically, completely, and meaningfully. Though advances continue to be made in developing instrument-based analysis, human senses remain unmatched in their sensitivity for detecting and evaluating organoleptic characteristics of food. The U.S. Food and Drug Administration and NOAA's National Marine Fisheries Service routinely employ sensory evaluation in inspecting seafood quality. Seafood inspectors are essentially sensory analysts, or assessors, who work as expert evaluators in the application of product standards. A major objective of seafood sensory inspection is to evaluate quality with regard to decomposition of fisheries products. Sensory analysis can also provide information on presence of taint from external sources, such as spilled oil and chemicals.

Sensory panels

Objective sensory evaluation of seafood is usually conducted using a panel of trained and experienced analysts. Sensory analysts must be screened for sensitivity and then trained in applying established sensory science methodology. Participation in calibration or “harmonization” workshops ensures uniform application of sensory evaluation criteria for particular types of contaminants, including standard terminology and consensus on levels of intensity of sensory characteristics. Descriptive analyses and references are used to yield results that are consistently accurate and precise.

There are different types of sensory analysts, which function differently and have specific selection, training, and validation requirements. *Trained assessors* are sensory analysts selected and trained to perform a specific task. *Expert assessors* are the most highly trained and experienced category of sensory analyst. Expert assessors generally evaluate product full-time, function independently, and often are used in quality control and product development. Examples of products evaluated by expert sensory assessors include wine, tea, coffee, and seafood. Through extensive standardized training and experience with sensory methodology, these expert assessors have become extremely objective and evaluate quality with a high degree of accuracy and precision. Seafood inspectors fall into the category of expert assessors, and can make consistent and repeatable sensory assessments of quality characteristics of seafood as they relate to grade level or decisions to accept or reject product.

The number of panelists needed depends on the level of expertise and experience of the analysts used. For panels of expert assessors, such as NMFS and FDA seafood inspectors, usually only three to five analysts are needed. If less experienced analysts are used, a larger number of panelists is recommended. Whenever possible, use of expert seafood assessors, such as seafood inspectors, is recommended for evaluation of seafood for presence of petroleum taint. Extensive product knowledge and experience enable seafood inspectors to very accurately distinguish variations related to product processing, storage, deterioration, etc. from taint due to external sources. Some seafood inspectors for NMFS and FDA have had specialized training for detecting petroleum taint in seafood and experience evaluating seafood samples at oil spills. If called upon, these specialized inspectors are available to conduct sensory evaluation of seafood during spill events.

Sensory evaluation procedures

Applied as a science, sensory evaluation should be conducted under specific, highly controlled conditions in order to prevent extraneous influences in the testing environment from affecting panelists’ sensory responses. Accordingly, sensory testing is best conducted in facilities specifically designed for sensory testing. The NMFS Seafood Inspection Branch maintains several such laboratories around the country. Seafood samples collected during a spill event can be shipped to these laboratories for sensory evaluation. In most cases, NMFS and FDA recommend that samples be shipped and evaluated in the same manner as they normally are shipped and sold (*i.e.*, fresh, live, frozen). When this is not possible, as may be the case for oil spills in very remote areas, sensory analysts can conduct evaluations at the scene of an incident.

All sensory testing should be conducted under the supervision of a sensory professional, who designs and implements the sensory testing procedure. A trained “facilitator” should coordinate sensory analysis. The facilitator conducts the testing, including receiving, preparing, and presenting samples to the expert sensory panel, and collecting the resulting data in a scientific and unbiased manner. All of these steps should be conducted according to standardized procedures under highly controlled conditions. Suspect samples are presented to assessors in blind tests, along with control or reference samples. Samples are first smelled raw, then smelled cooked, and finally tasted by each panelist independently to determine whether petroleum taint is present. A sensory professional statistically analyzes panelist’s responses to determine whether samples pass or fail with regard to presence of petroleum taint. These results, in turn, help seafood managers determine whether restrictions are needed on seafood harvest or marketing from the spill area due to tainting.

We are not certain which compounds in petroleum are responsible for taint perceived by humans, so chemical analysis cannot yet substitute for sensory testing in determining whether a taint is present. It has been suggested that the principal components of crude and refined oils responsible for tainting include the phenols, dibenzothiophenes, naphthenic acids, mercaptans, tetradecanes, and methylated naphthalenes. The human olfactory system generally is very sensitive to phenolic and sulfur compounds, even though they are minor components of oil.

In 2001, NOAA published a technical guidance document on appropriate sensory methodology to objectively assess seafood for the presence of petroleum taint. Written by sensory scientists with NOAA's National Marine Fisheries Service Seafood Inspection Program and Canada's Food Inspection Agency, in cooperation with the U.S. Food and Drug Administration, *Guidance on Testing and Monitoring of Seafood for Presence of Petroleum Taint Following an Oil Spill* comprehensively describes recommended standard procedures, including collection, preservation, and transport of seafood samples, for sensory evaluation. The guidance is intended to assist in conducting scientifically sound and legally defensible sensory tests on seafood during oil spill response, with adequate and appropriate quality control.

Chemical testing techniques for petroleum contaminants in seafood

Chemical testing of seafood often is conducted after an oil spill to determine whether seafood tissues are contaminated with petroleum compounds. Both detailed and screening methods of analysis can be employed. Below, we summarize methods typically used after past oil spills, including some of their advantages and disadvantages.

DETAILED METHODS OF CHEMICAL ANALYSIS: GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Detailed chemical analysis of seafood after oil spills typically is conducted using gas chromatography and mass spectrometry (GC/MS), which measures individual PAHs at very low detection levels and provides a PAH pattern (or fingerprint) to compare to that of the source oil. Prior to analysis, hydrocarbons are extracted from seafood tissue samples and the extract is split into three fractions: 1) the saturated hydrocarbons fraction (containing the n-alkanes, isoprenoids, steranes and triterpanes; 2) the aromatic hydrocarbon fraction (containing the PAHs and sulfur heterocyclics; and 3) the polar hydrocarbon fraction (containing the nitrogen heterocyclic compounds. Recovery standards appropriate to each fraction are added.

The PAHs in the fraction generally are of greatest concern with regard to risk to human health. The gas chromatograph separates targeted PAH compounds yielding a retention time that, in combination with the mass spectra from the mass spectrometer, enable detailed identification of individual compounds by their ion masses. The method often used is usually referred to as "Modified" EPA Method 8270, which is EPA Method 8270 for semi-volatile compounds modified to include quantification of the alkyl-substituted PAH homologues, in addition to the standard PAH "priority pollutants." In oil, alkylated homologues of PAHs are more predominant than parent PAH compounds, often by an order of magnitude. This is in contrast to pyrogenic (combustion) and other potential PAH sources. The detailed chemical fingerprint provided by GC/MS analysis enables differentiation among sources of PAHs found in the sample. Contamination from a specific spill can be distinguished from background sources of contamination, such as PAHs derived from combustion sources. GC/MS can also measure analytes other than PAHs to help with fingerprint analysis of oil or to track oil weathering. The GC/MS can be run in the selected ion monitoring (SIM) mode, rather than the full-scan mode, to increase the minimum detection levels (MDL) of the individual parent and selected homologue PAHs by a factor of 10 to 40. Minimum detection levels for individual PAHs are very low, in the range of parts per billion (ng/g) in tissue. The quantitative results for specific, targeted PAHs can be used to assess whether levels detected pose a risk to human health through seafood consumption.

Normal turnaround time for analysis of tissue samples for PAHs is approximately two weeks. Fast turnaround time is approximately three days for a batch of samples. Costs for GC/MS-SIM analysis of tissues are relatively high, starting from about $750 per sample, plus premiums of 50-100% for fast turnaround. The sample-processing rate depends on the throughput capabilities of the laboratory and the degree of quality control (QC) of the data before the results are released, ranging from approximately 20 to a maximum of 100 samples per week.

Data Reporting and Interpretation

The importance of data reporting and interpretation should not be underestimated in plan-ning seafood safety monitoring programs after oil spills. Some simple steps can be taken to help avoid confusion and prevent incorrect conclusions. For example, the analytical laboratory should include at least the following information for all analytical data reported:

Header Information

- *Sample Name or Field ID: the sample name or number assigned by the sampler*
- *Sample Type: e.g., sample, field blank, trip blank, procedural blank, QC*
- *Batch No.: analytical batch number (so samples run as a batch can be identified, particularly if problems are found with a batch run)*
- *Matrix: e.g., water, sediment, tissue, oil*
- *Percent Moisture: for tissue and sediment samples*
- *Sample Size: weight or volume of sample used for analysis*
- *Collection Date: date the sample was collected*
- *Extraction Date: date the sample was extracted*
- *Analysis Date: date the sample was analyzed*
- *Analysis Method: EPA Method or other description*
- *Surrogate Corrected?: Are the reported concentrations corrected for surrogate recovery?*
- *Method Detection Limit: the minimum detection level*
- *Units: units in which the concentration is reported, including whether concentrations are wet weight or dry weight (for tissue)*

Analyte Data

- *Individual and Total PAH concentrations*
- *Surrogate Recovery (%): for every sample*
- *Key to Data Qualifiers: The lab should include a key to any qualifiers used to flag reported values that have some kind of data accuracy issue. For example, two standard qualifiers used under the USEPA Contract Laboratory Program guidelines (USEPA 1994) are:*
- *U = the analyte was analyzed for, but was not detected above the reported sample quantification limit*
- *J = the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample*

Analysis of the source oil, if available, is needed to enable fingerprint comparisons. Only expert petroleum hydrocarbon chemists should interpret fingerprints because the complex processes of oil weathering and uptake result in variable PAH patterns in organisms. Also, patterns can be difficult to interpret in samples collected from areas with high background levels of contamination.

Caution is advised when comparing analytical results for samples of different types, or samples collected from different areas or at different times. Before drawing conclusions, consider any differences in the analyses conducted or the way the data are reported. Examples of differences to watch for include:

- The units in which results are reported, and whether reported concentrations are dry or wet weight;
- Whether the lists of analytes and minimum detection limits for individual PAHs are the same;
- Whether reported concentrations have been corrected for surrogate recovery; and
- Whether reported concentrations have been lipid-normalized. PAH uptake and retention tend to increase with the increasing lipid content of tissues. Consequently, differences in lipid content

may need to be considered when comparing and interpreting analytical results over time or among different organisms.

Rapid screening methods of analysis

Rapid, low-cost analytical methods, generally known as screening methods, can be employed to identify contaminated samples and prioritize them for detailed analysis. Detailed methods of analysis for PAHs in tissue are time-consuming and expensive. The large number of samples often collected after an oil spill can quickly overwhelm laboratory capacity and strain resources. Screening methods of analysis can rapidly process large numbers of samples to yield semi-quantitative estimates of contaminant concentrations and allow ranking of samples by degree of contamination. Used in a tiered approach, screening methods can identify the most contaminated samples, prioritizing or reducing the number of samples that need to be processed by detailed analytical techniques, such as GC/MS.

For example, in response to the need to analyze large numbers of subsistence seafood samples collected after the *Exxon Valdez* oil spill in Prince William Sound, Alaska, NOAA's Northwest Fisheries Science Center used reverse-phase, high performance liquid chromatography (HPLC) with fluorescence detection to screen for metabolites of aromatic compounds in finfish bile. Finfish rapidly metabolize aromatic compounds and concentrate the resulting metabolites in bile for excretion, often at concentrations that are orders of magnitude greater than those in edible tissue. Using this rapid, low-cost method, hundreds of finfish tissue samples were screened for indication of exposure to petroleum contaminants, enabling GC/MS analyses to be focused on selected samples to confirm presence and quantities of individual contaminants. HPLC/UV fluorescence screening methods have also been used for rapidly measuring aromatic compounds in invertebrate tissues. This screening method was used successfully on lobster samples collected after the *North Cape* oil spill off the coast of Rhode Island in 1996.

Screening analyses, such as the HPLC/fluorescence method described above, generally can be completed in rapid turnaround time (within 24 hours) and can be conducted on a research vessel or onshore lab. Rapid availability of results enables sampling modifications based on indications of exposure. This can be very helpful during the critical early phases of an oil spill response, when decisions regarding closing or otherwise restricting seafood harvest may be made.

The utility of HPLC/fluorescence and other screening methods, however, is more limited than detailed methods of analysis. For example, though it may be possible to recognize chromatographic patterns associated with characteristic classes of petroleum products, HPLC/fluorescence screening does not produce a detailed "fingerprint" similar to the results acquired from GC/MS. Consequently, HPLC/fluorescence usually will not enable differentiation between background contamination sources and the spilled oil, especially in very polluted areas. Since HPLC/fluorescence screening does not quantify individual aromatic compounds, the results cannot be used to assess risk to human health from consumption of contaminated seafood. Furthermore, measurement of fluorescent aromatic compounds in bile is not a standard analysis, limiting temporal and spatial comparisons using historical data sets. Lastly, HPLC/fluorescence screening for fluorescent aromatic compounds in bile is a specialized technique, and laboratory availability and expertise needed to conduct the analyses reliably may be limited.

Water Monitoring

Water samples often are collected and analyzed as part of the initial spill response and assessment. Seafood safety managers can use these results to help estimate the extent and duration of seafood exposure to oil in the water column. Monitoring water concentrations may also be important if water-quality criteria are applied as a condition for reopening a closed fishery or removing other harvest restrictions.

Oil concentrations in the water column generally peak early after an oil spill and, in most cases, rapidly decline to background levels within days to a week, as was the case for example at the *New Carissa* oil spill. Accordingly, if water sampling is to be conducted, initial sampling should commence very soon after a spill occurs. Oil may persist longer than usual in the water column if there are multiple or ongoing oil releases, if the released volume is extraordinarily large, or if large volumes of oil are physically dispersed. After the *Braer* oil spill, for example, elevated oil concentrations were detected in the water column as long as 50 days after release. Dissolved and dispersed oil plumes in the water column are driven by currents and so may have a very different spatial distribution than surface slicks, which are driven primarily by wind.

Under the authority of the Clean Water Act (63 FR 68354-68364), EPA has issued national recommended water-quality criteria for priority toxic pollutants to be used by states and tribes in adopting water quality standards. EPA has issued water-quality criteria for protection against human health effects for three mono-aromatic hydrocarbons and eight PAHs (listed in Table G.2-3). These particular compounds, however, are present in crude oils and refined products at very low levels and constitute a tiny percentage of the PAHs normally detected in water samples after an oil spill. None of the water quality criteria to protect aquatic communities (both freshwater and saltwater) issued by EPA are for PAHs. EPA has issued recommended water quality criteria for organoleptic effects for 23 chemicals, though not for any of the compounds present in petroleum products. Some states have established state water quality standards for PAHs in their coastal waters.

Sediment Monitoring

Sediment monitoring can be included as part of a post-spill monitoring program to determine whether sediments may be a potential chronic source of oil exposure to adjacent seafood collection sites, particularly at intertidal sites where bivalves are harvested. Sediment sampling also may facilitate fingerprint analysis of PAHs in tissues by providing the PAH pattern in contaminated sediments, which may be different than the PAH pattern in the fresh source oil. It is important to recognize, however, that sediments often contain high levels of background PAH contamination, particularly in urban areas and harbors. PAHs and other contaminants detected may not be

related to a particular oil spill. Also, characterization of sediment contamination can be difficult because of the inherent heterogeneity of intertidal sediments over space, depth, and time.

There are no national sediment quality criteria for PAHs in marine or freshwater sediments. Some states have established sediment quality standards and cleanup screening levels to prevent adverse biological effects. How these standards would relate to seafood adulteration or safety issues is unclear.

Table G.2-3 National recommended water quality criteria for priority toxic pollutants for protection agains human health effects.

PAH priority pollutant	Human health criteria for consumption of water + organism (µg/L)	Human health criteria for consumption of organism only (µg/L)
Benzo[a]anthracene	0.0044	0.049
Benzo[a]pyrene	0.0044	0.049
Benzo[a]fluoranthene	0.0044	0.049
Benzo[k]fluoranthene	0.0044	0.049
Dibenzo[a]anthracene	0.0044	0.049
Fluoranthene	300	370
Fluorene	1300	14000

SEAFOOD RISK ASSESSMENT

(Risk assessment and determination of caner risk should be conducted by the California Department of Health Services).

Several different endpoints can be considered when assessing risks posed to human health from consuming contaminated seafood. These include both carcinogenic and non-carcinogenic effects to the general population, as well as to particularly susceptible segments of the population such as children, pregnant women, and subsistence seafood consumers. Human epidemiological studies, when available, and laboratory studies involving animals are used to assess the likely effects of contaminants at various exposure levels.

Evidence from occupational studies of workers exposed to mixtures of PAHs indicates that many of these compounds may be carcinogenic to humans. Individual PAHs that are considered to be probable human carcinogens include benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene (IRIS 1994). Most of the data gathered from laboratory studies provides information on carcinogenic effects of lifetime exposure to PAHs. Information on non-carcinogenic effects is limited. Consequently, cancer generally is the primary endpoint considered when assessing potential risks to human health from consumption of seafood from an oil spill area.

Seafood Advisory and Action Levels from Previous U.S. Oil Spills

The action or advisory levels resulting from cancer risk calculations differ among spills, depending on the assumptions made and input values selected. At the *New Carissa* oil spill, the Oregon Health Division calculated action levels for average and upper end shellfish consumers of 45 ppb BaP equivalents (BaPE) and 10 ppb BaPE, respectively. Action levels derived by the California Department of Health Services for average and upper-end shellfish consumers following the *Kure* spill were 34 ppb BaPE and 5 ppb BaPE, respectively. At the *North Cape* oil spill, the Rhode Island Department of Health essentially applied a BaPE criterion of 20 ppb for the maximally exposed lobster consumer over the five-year exposure duration. Action levels calculated by the Maine Bureau of Health for lobster consumption after the *Julie N* oil spill for ten and 30- year exposure durations were 50 ppb and 16 ppb BaPE, respectively. Advisory levels for subsistence consumers after the *Exxon Valdez* oil spill, assuming a ten-year exposure period, were three ppb BaPE for salmon, five ppb BaPE for finfish, 11 ppb BaPE for crustaceans, and 120 ppb BaPE for bivalve mollusks. Advisory levels based on a lifetime exposure assumption were approximately an order of magnitude lower. None of the finfish or shellfish samples collected from harvesting areas near Prince William Sound exceeded these advisory levels. Interestingly, the upper-bound lifetime cancer risk for Alaskan subsistence seafood consumers eating the most contaminated bivalve mollusks from the spill area was calculated to be two orders of magnitude lower than the lifetime risk calculated for consumers of locally smoked salmon

.

At several of these spills, the calculated action levels were used as recommended levels for reopening harvest of closed seafood fisheries. For example, at the *New Carissa* oil spill, shellfish were considered safe if all samples contained less than 10 ppb BaP equivalents. If any shellfish tissue levels were above 45 ppb BaP equivalents, shellfish in those areas would be considered unsafe, and further monitoring considered necessary. If samples contained more than 10 ppb but less than 45 ppb BaP equivalents, the need for further monitoring would be assessed on a case-by-case basis. A similar tiered approach was used at the *Kure* oil spill. If all samples contained less than 5 ppb BaP equivalents, shellfish beds could be reopened. If any samples contained between 5 and 34 ppb BaP equivalents, the need for further action before reopening would be assessed. If any samples contained more than 34 ppb BaP equivalents, additional sampling and environmental monitoring prior to reopening would be considered.

The Equivalency Approach for Risk Assessment

The equivalency approach used in relative cancer risk assessment is a method used for assessing the risk of exposure to a mixture of several different compounds that are related in terms of chemical and biological activity. Rather than calculating individual risks for each compound, one component of known potency is used as a standard. Concentrations of each of the other compounds are adjusted based on their estimated potency relative to the standard, to calculate an equivalent concentration for the standard. Summing the equivalent concentrations yields a single number from which the cancer risk can be estimated.

This toxicity equivalency approach has been widely used for mixtures of dioxins and furans, for example. The relative potencies of individual dioxin and furan compounds are expressed in terms of 2,3,7,8-tetra-chlorodibenzo-*p*-dioxin (2,3,7,8-TCDD) equivalents. 2,3,7,8-TCDD was chosen as the standard by which the potency of individual dioxin and furan compounds are estimated because most laboratory studies on the effects of dioxins have been conducted using 2,3,7,8-TCDD. Data are more limited on the effects of other congeners. The same approach can be used with petroleum compounds, which also occur in complex mixtures.

SEAFOOD TAINT RISK COMMUNICATION

Both technical and social factors should be considered when communicating information on the health and safety of seafood following an oil spill, particularly when dealing with different groups. The risks and consequences have different meanings for the subsistence user, sport fisher, average consumer, commercial fisher, elected official, regulator, and responsible party representative. Regulators and scientists measure risk quantitatively and accept the uncertainty inherent in the risk-assessment process. The public perceives risk more qualitatively and subjectively, and is influenced by prior experience with similar risks and information made available to them. The public wants to know whether the seafood is safe to eat; yet the answers given are typically posed in terms of “acceptable risk” or “not a significant risk.” Risk communicators should be aware of and try to overcome: 1) gaps in knowledge, 2) obstacles inherent in the uncertainties of scientific risk assessment, and 3) barriers to effective risk communication.

Please see Appendix F for further general information on risk communication approaches and techniques. In addition:

- Meet directly with groups such as commercial fishing associations, recreational users, subsistence users, seafood vendors, etc. Meetings can fail if the risk communicators are not prepared or knowledgeable, or appear to be withholding information. Specialized bulletins or communication methods may be necessary for special groups, such as Native American subsistence users and non-English-speaking users.
- Use unambiguous terms whenever possible. Health risks are commonly described in terms of probabilities of cancer based on assumed consumption rates and periods. It is assumed that carcinogens do not have safe thresholds for exposures; that is, any exposure to a carcinogen may pose some cancer risk (USEPA 2000b). However, it is both useful and appropriate to define “safe” and “unsafe” levels of PAHs in seafood based on risk rates that are commonly considered to be acceptable. For example, water-quality criteria for carcinogenic contaminants in water usually use risk rates in the range of 10^{-5} to 10^{-6}. The general public understands the concepts of acceptable risks, although there may be components of society where these risks conflict with local cultures, such as the Alaska Native subsistence users during the *Exxon Valdez* oil spill. As long as the risk communicators clearly define what is meant by “safe” and “unsafe,” these terms are appropriate.

Communicating Relative Risks

Risk communicators commonly compare the relative risk of a specific activity to known risks of other activities. For example, the public is accustomed to hearing the risks of death by automobile accident or airplane crash.

These are considered voluntary risks taken by people who decide to drive or fly after considering the risks and benefits associated with these activities, whether or not their perceptions are realistic. The public generally will accept risks from voluntary activities that are roughly 1,000 times greater than involuntary risks that provide the same level of benefits.

Because the potential human-health risks from eating seafood contaminated by an oil spill are associated with PAHs, it is tempting to compare the PAH levels in seafood samples with those found in other food sources. PAHs are ubiquitous contaminants, measurable in many foods. Based on information from previous spills, PAH levels in seafood from oil-spill-contaminated waters generally are considerably lower than PAH levels found in smoked foods. During the *Exxon Valdez* oil spill, however, village community residents became upset when it was pointed out that samples of smoked fish from the villages contained carcinogenic hydrocarbon levels hundreds of times higher than any shellfish samples collected from oiled beaches, and nearly 10,000 times higher than wild salmon. The residents considered eating smoked salmon to be an acceptable, voluntary risk, and eating oil-contaminated seafood to be an involuntary, unacceptable risk. Guidelines for risk communication include being sensitive to the distinction between voluntary and involuntary risk, and avoiding risk comparisons that equate the two. Risk comparisons should be made carefully.

APPENDIX H

NATIONAL CONTINGENCY PLAN (NCP) PRODUCT LIST

Within the U.S. only dispersants that have met the approval criteria set by the U.S. Environmental Protection Agency (EPA) and that are listed on the EPA National Contingency Plan (NCP) Product Schedule can be legally sprayed. The NCP Product Schedule includes the following products:

- Corexit 9527
- Corexit 9500
- DISPERSIT SPC 1000
- JD-109
- JD-2000
- NEOS AB 3000
- MARE CLEAN 200

Updated NCP Product Lists can be accessed via the EPA representative on the RRT (Appendix A), by calling the Emergency Response Division of the U.S. EPA (202-260-2342) or accessing the internet at http://www.epa.gov/oilspill/ncp/dsprsnts.htm

APPENDIX I

STATE LICENSED OIL SPILL CLEANUP AGENTS (OSCA)

In addition to meeting the approval criteria set by the EPA, dispersants used in California must be a California state-licensed Oil Spill Cleanup Agent (OSCA). Dispersants currently meeting the state-licensing requirements are:

- Corexit 9527
- Corexit 9500

Additional information on California state-licensed dispersants may be obtained by calling Yvonne Addassi (OSPR), pager number 916-857-9550.

APPENDIX J

Federal On-Scene Coordinator (FOSC)

Guidelines and Checklist for Dispersant Use in Marine Waters Designated RRT Approval Required Zones (December 2003)

Purpose and Authority

The information outlined in this Appendix delineates the Regional Response Team (RRT) IX policy and procedures for the use of dispersants in response to oil discharges within California State or National Marine Sanctuary waters or marine waters within 3 miles of the borders of Mexico or the state of Oregon.

This policy authorizes and provides guidelines to allow the federally pre-designated U. S. Coast Guard (USCG) Federal On-Scene Coordinator (FOSC) and/or the Unified Command to use dispersants in a timely manner to: 1) prevent or substantially reduce a hazard to human life, 2) minimize the adverse environmental impact of the spilled oil, and 3) reduce or eliminate the economic or aesthetic losses of recreational areas. This policy addresses the use of dispersants in the RRT Approval Required Zones. This Appendix is a subset of the California Dispersant Plan (CDP) and all additional appendices and forms identified within this document can be found within the CDP.

Subpart J of the National Contingency Plan (NCP) provides that the FOSC, with the concurrence of the U.S. Environmental Protection Agency (EPA) representative to the Regional Response Team and the State with jurisdiction over the navigable waters threatened by the oil discharge, and in consultation with the U.S. Department of Commerce (DOC) and U.S. Department of the Interior (DOI) natural resource trustees, when practicable, may authorize the use of dispersants on oil discharges; provided, however, that such dispersants are listed on the NCP Product Schedule. The EPA has been delegated authority to maintain a schedule of chemical countermeasures that may be authorized for oil discharges in accordance with procedures set forth in Section 300.900 of the NCP.

The USCG Eleventh District Commander has pre-designated the three USCG Captains of The Port (COTP) as the FOSCs for oil discharges in their respective COTP zones (as defined in 33 CFR Part 3 and subject to joint response boundary agreements with EPA described in Section 1400 of the three California Area Contingency Plans), and has delegated to each COTP the authority and responsibility for compliance with the Federal Water Pollution Control Act (FWPCA).

The Governor of the State of California has designated the Administrator of the Department of Fish and Game Office of Oil Spill Prevention and Response (CDFG-OSPR) the authority and responsibility for providing approval for the use of dispersants for control of oil spills in or affecting California waters.

The USCG, EPA, DOI, DOC/NOAA, and CDFG OSPR agree that one of the primary methods of controlling discharged oil shall be the physical removal of the oil by mechanical means. These agencies recognize that in certain instances timely, effective physical containment, collection and removal of the oil may not be possible, and the utilization of dispersants, alone or in conjunction with other removal methods, may be considered to minimize substantial threat to public health or welfare, or minimize serious environmental damage. This document outlines the guidelines under which dispersants listed on the NCP Product Schedule may be used by the FOSC in California State and National Marine Sanctuary waters.

Background

The National Oil and Hazardous Substances Pollution Contingency Plan (National Contingency Plan - NCP) directs RRTs and Area Committees to address, as part of their planning activities, the desirability of using appropriate dispersants, surface washing agents, surface collecting agents, bioremediation agents, or miscellaneous oil spill control agents listed on the NCP Product Schedule, and the desirability of using appropriate burning agents. Regional Contingency Plans and Area Contingency Plans shall, as appropriate, include applicable authorization plans and address the specific contexts in which such products should and should not be used (40 CFR § 300.910).

The use of dispersants in marine waters off California requires detailed foresight and planning. In an effort to expedite a decision to use dispersant and reduce first strike response time, the Regional Response Team (RRT) IX in August of 2000 adopted formal changes to the planning and operations sections of the Regional Contingency Plan (RCP). These sections detail a dispersant use planning process to be undertaken by each of the six California marine Area Committees (AC). Specifically, each AC was tasked with recommending designated approval zones for dispersant use within its area of operation and the development of a dispersant use plan to include at least the following: 1) Incident Command System (ICS) protocols and forms, 2) Federal On-Scene Coordinator Checklists, 3) dispersant monitoring plan, and 4) wildlife spotting protocols. Finally, each committee was asked to review training and drill requirements for plan implementation as well as for a 4-hour dispersant response time.

To further these requirements and as expected by the RRT, the Area Committees are implementing this task in a step-wise manner. The first task, designation of approval zones, has been completed by all Area Committees. In February 2003, the last Area Committee zone recommendation was approved by the RRT and now, all the marine waters off the State of California have been designated as "dispersant pre-approval zones" or "RRT approval required zones" for the use of dispersants. The task now before the Area Committees involves the development of a dispersant use plan. Taking into account the degree of overlap and limited staff resources, a few agency individuals agreed to draft a statewide dispersant use plan, which once completed, could be modified for incorporation into both local area contingency plans as well as the Regional Contingency Plan. This document will also serve as the record of notice for the Federal Notice Register and in furtherance of the public review process as required by the National Environmental Protection Act (NEPA).

Protocols for dispersant use

The FOSC shall arrive at a decision to use dispersants using the information-gathering and decision-making process outlined below, and, using the checklists and procedures attached to this document, forward this information to the RRT for approval. These protocols presume that the FOSC has previously determined that a proposed dispersant use does not meet the criteria of pre-approval, but that dispersant use under a case-by-case RRT approval authority is being pursued.

RRT approval required for dispersant use

For those spill situations that are not addressed by the pre-approval process, FOSC authorization to use dispersants requires the concurrence of the RRT Co-Chairs (the U.S. Coast Guard and U.S. EPA) and State representatives to the RRT and in consultation with the DOI and DOC representatives. The RRT must approve the use of dispersants at the time of a spill for all scenarios within the designated marine waters:

- Marine waters within 3 nautical miles from the coastline, waters designated as a part of a National Marine Sanctuary, or waters that are within three miles of the borders of the Country of Mexico or the State of Oregon; or,

- Marine waters one mile from anadromous fish streams during times of emigration and immigration.

Once an FOSC determines to pursue the use of dispersants in a non-pre-approval zone, a formal evaluation of the trade-offs associated with this proposed dispersant use must be conducted. The forms and checklists found in the **DISPERSANT APPROVAL ASSESSMENT FORM** below are designed to assist the FOSC or his/her designee in making this determination. The following is an overview of pertinent decision-making points:

- The spilled oil must be amenable to chemical dispersion. Diesel is strictly prohibited from dispersant-use;
- Oceanographic conditions allow for the effective and safe use of dispersants;
- The use of dispersants provides a net environmental benefit. Of special concern are kelp beds and marine waters less than 60 feet deep;
- Appropriate dispersants, dispersant application equipment and personnel are available.

Once the FOSC has filled out the checklists and forms and has determined dispersant use would be a viable and appropriate response option, the FOSC must put in a formal request for approval to the RRT. A spill-specific RRT conference call will be conducted in which all aspects of the dispersant-use request will be evaluated. The RRT will provide the FOSC with an answer regarding the dispersant approval request within 2 hrs of the formal request. The decision to use dispersants will be with approval of the RRT co-chairs and the representative of the State of California with consultation from the DOI and DOC. It is likely that the RRT will address similar stipulations as outlined in the pre-approval process, such as the following;

- Dispersants should not be applied directly to marine mammals within or outside of an oil slick;
- Dispersants will be applied in such a way as to avoid, to the maximum extent practicable, the spraying of seabirds outside the oil slick being treated;
- During the actual dispersant application operations, the sea surface area designated for dispersant application should be assessed by trained wildlife observers in the spotter aircraft for the presence of marine birds and mammals to avoid inadvertent spraying.
- The effectiveness of the dispersant application should be monitored at a minimum by observers trained is dispersant use and if possible with the Special Monitoring of Applied Response Technologies (SMART) monitoring program.

DISPERSANT APPROVAL ASSESSMENT FORM

(Information provided for this form will assist in the dispersant use determination by the FOSC)

This report made by: ________________________ Organization: ___________________ Date: __________ Time: __________
Phone: ( )____________Fax: ( )______________ Mobile: ( )_____________________ Pager: ( )____________________

On-Scene Commander: ______________________ Agency: ____
Phone: ( )____________ Fax: ( )______________ Mobile: ( )_____________________ Pager: ( )____________________

Caller: ____________________________________ Organization: ___________________ Date: __________ Time: __________
Phone: ( )____________ Fax: ( )______________ Mobile: ( )_____________________ Pager: ( )____________________
Street: ____________________________________ City __________________________ State _______ Zip Code __________

SPILL

Date of spill: _________________(month/day/year) Time of spill: ______________________________(PST, 24-hr clock)
Location: Latitude: _______________________N Longitude: ____W

Spill source and cause: ____
____

Amount spilled: _______________(gal or bbl) Type of release: ❑ Instantaneous ❑ Continuous
Flow rate if continuous flow (estimate): ____________
Oil name: ___________________________________ API: ________ Pour point: __________ (ºC or ºF)
Circle one
Information source: ____

ON-SCENE WEATHER

(If not immediately available contact NOAA Scientific Support Coordinator (206-321-3320) or other resources noted in Appendix A).

Wind (from) direction: ___________________ Surface current (direction toward, in degrees): ___________________
Wind speed: ______________ (miles/hr or knots) Current speed: __________(knots)
Circle one

Visibility: _______________ (nautical miles) Ceiling: ________ (feet) Sea state:________ (wave height in feet)
Information source:____

DISPERSANT SPRAY OPERATION

Dispersant spray contractor name: ______________________________________ Street: ____________________________
Dispersant name: _______________________ Quantity available: _________ City: ____________________________
State: ________ Zip Code: _____________
Phone: ( )______________________

Platform: Aircraft type: ❑ Multi-engine ❑ Single-engine
Boat type: __________________________________
Other: __________________________________
Dispersant load capability (gal): _____________________

FOSC Complete:

"Window of opportunity" for getting dispersant on the oil: _________________________ (hrs from first report of spill)
Number of daylight hours available for first day of dispersant application:_____________ (hrs from first report of spill)
Time to first drop on the oil: ____ (hrs from first report of spill)

Can dispersants to be effective after day one of the spill? YES / NO / MAYBE
(circle one)

BIOLOGICAL RESOURCES AT RISK (Provided by OSPR and other Resource Trustees. When the spill is in a National Marine Sanctuary, Sanctuary representatives can assist with valuable resource information. See Appendix A for NMS contact information.).

On-Water Resources:____
____
____
____
____
____

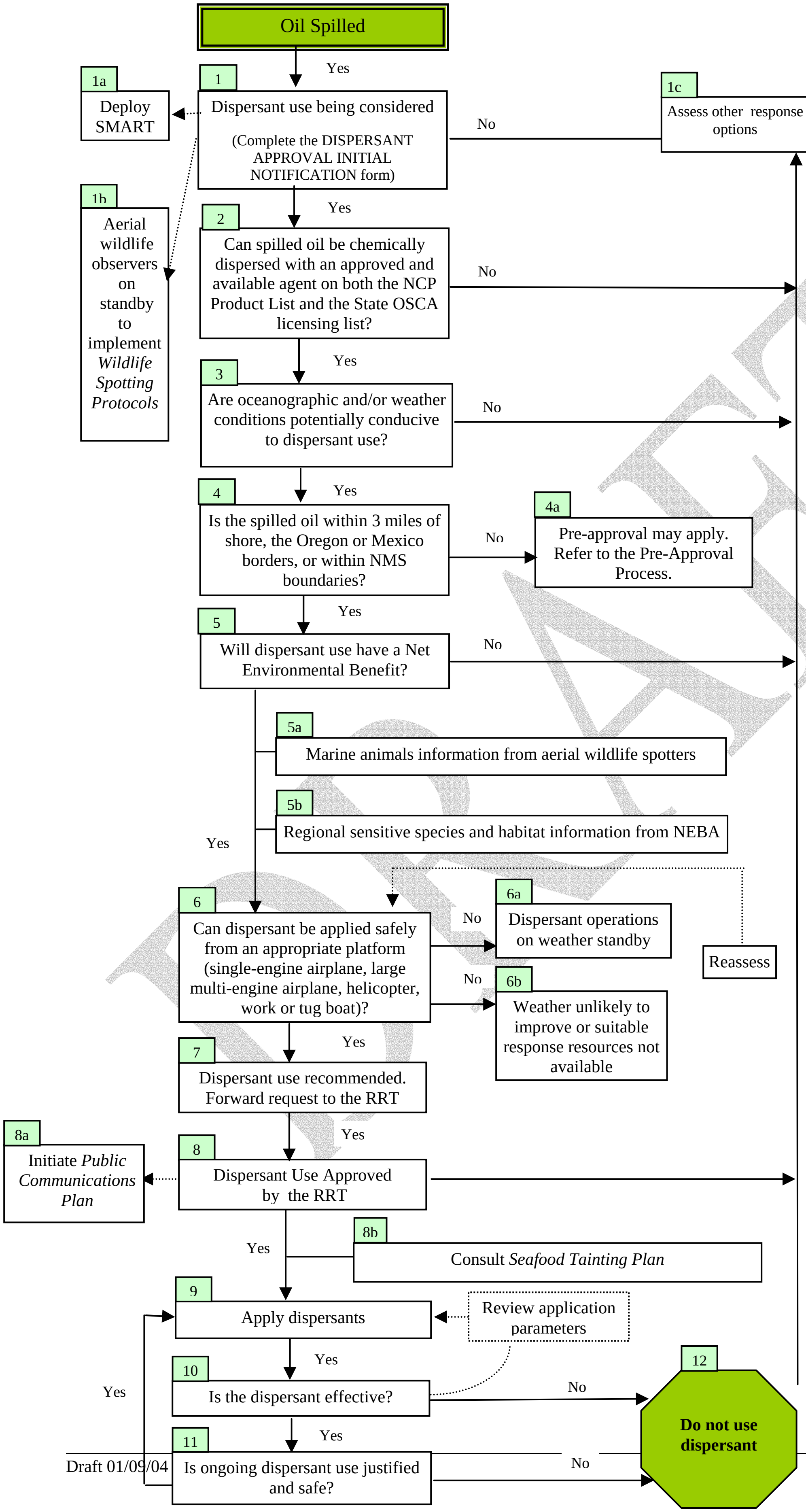
Shallow Subtidal Resources ____
____
____
____
____
____

Intertidal Resources: ____
____
____
____
____
____
____

Anadromous Resources: ____
____
____
____
____

Significant Water Column Resources: ____
____
____
____
____
____

DISPERSANT USE FLOWCHART: RRT APPROVAL REQUIRED ZONES



Dispersant Decision Summary

Spill location: ____________________

Decisions approved by: ________________

Box	Decision	Time:	Date:	Initials:
1	Yes/No	___	_______	_______
2	Yes/No	___	_______	_______
3	Yes/No	___	_______	_______
4	Yes/No	___	_______	_______
5	Yes/No	___	_______	_______
6	Yes/No	___	_______	_______
7	Yes/No	___	_______	_______
8	Yes/No	___	_______	_______
9	Yes/No	___	_______	_______
10	Yes/No	___	_______	_______
11	Yes/No	___	_______	_______
12	Do Not Use	___	_______	_______

Comments:

....

BOX 1 **IS DISPERSANT USE BEING CONSIDERED?**

Dispersant use should be considered if:

- ❒ Oil is likely to significantly impact birds, marine mammals, or other flora and fauna at the water surface
- ❒ Natural dispersion is limited
- ❒ Other response techniques are unlikely to be adequate, effective, or economical
- ❒ The oil could emulsify and form mousse or tar balls
- ❒ Oil is likely to significantly impact shorelines, structures and facilities (*e.g.*, marinas, wharves)
- ❒ Oil is likely to significantly impact economically important resources (*e.g.*, shellfish beds, tourist beaches)
- ❒ Other ………

Decision: Consider dispersant use?

			Date	Time
❒	Yes	Make notifications in **Box 1a**	……….	……….
		Make notifications in **Box 1b**	……….	....
❒	No	Go to **Box 1c**	……….	……….

From Cawthron, 2000.

Discussion Note 1.1 **KEY BENEFITS OF DISPERSANT USE**

- Dispersant use minimizes the effects of an oil spill principally by dispersing oil before it reaches shorelines or sensitive areas (*e.g.*,wetlands, estuaries).
- Removing oil from the surface of the water reduces the potential for impacts to birds and marine mammals, and limits the action of wind on spill movement.
- Dispersants can prevent oil from sticking to solid surfaces, and enhance natural degradation.
- Dispersants can effectively treat large spills more quickly and inexpensively than most other response methods.
- Dispersants can be effective in rough water and strong currents where mechanical responses are limited.
- Effective dispersant responses can greatly reduce the quantity of oil requiring recovery and disposal.
- Dispersant use is often the only feasible response to spills that exceed mechanical response capabilities.
- Dispersant use does not generally limit other options, except oleophilic mechanical responses.
- Dispersed oil that cannot be mechanically recovered generally poses few significant environmental problems.

From Cawthron, 2000

BOX 1a **DEPLOY SMART**

Immediately deploy USCG Strike Team SMART to the spill site if dispersant use is likely. Every attempt should be made to implement the on-water component of the SMART monitoring protocols in every dispersant application. Dispersant application should not be delayed should sea conditions, equipment failure, or other unavoidable circumstances preclude the positioning of monitoring equipment and personnel. At a minimum, Tier 1 (visual) monitoring must occur during any dispersant operations approved in accordance with these Dispersant Approval Guidelines and Checklist. Tier 2 (on-site water column monitoring) and Tier 3 (fate and transport of the dispersed oil) SMART monitoring will be deployed as appropriate.

Decision: Deploy SMART?

			Date	Time
❒	Yes	Use contact information in Appendix A. Go to **Box 1b**.	………	………
❒	No	Note reason why not deployed. …………………………………………….	………	………
		…………………………………………….		

Go to **Box 1b** or **Box 1c** as appropriate.

BOX 1b **PLACE AERIAL WILDLIFE OBSERVERS ON STANDBY OR DEPLOY THEM TO IMPLEMENT THE *WILDLIFE SPOTTING PROTOCOLS***

Consider deploying trained wildlife spotters in initial spill overflight aircraft so that they can determine if the presence of marine animals in the spill or dispersant application zones could influence spray pattern decisions by the FOSC. The goal is to minimize over-spray onto unaffected animals. Wildlife spotters should use the forms and procedures given in the *Wildlife Spotting Protocols* (Appendix E and Appendix D.9). The FOSC will decide how subsequent and systematic wildlife spotting efforts can be safely conducted with the aerial resources available.

Decision: Notify/deploy aerial wildlife spotters?

			Date	Time
❒	Yes	Use wildlife spotter contact information in Appendix E. Go to **Box 2**.	………	………
❒	No	Note reason why wildlife spotters not deployed ……………………………… ………………………………………………………………………………	………	………

Reconsider under **Box 8**.

BOX 1c **ASSESS OTHER RESPONSE OPTIONS**

Consider all response options to identify which option, or combination of options, is most appropriate. The following options are described in Section 4500 of the Area Contingency Plan.

- No action other than monitoring
- Containment and recovery of oil at sea
- Clean-up of oil from shorelines
- *In situ* burning

Decision: Assess other response options?

			Date	Time
❒	Yes	Determine and implement most appropriate response.	………	………
❒	No	Monitor the spill as a minimum response option.	………	………

From Cawthron, 2000

BOX 2 **CAN SPILLED OIL BE CHEMICALLY DISPERSED WITH AN APPROVED AND AVAILABLE AGENT ON BOTH THE NCP PRODUCT LIST AND THE STATE OSCA LICENSING LIST?**

A NCP Product List may be found in Appendix H. Updated NCP Product Lists can be accessed via the EPA representative on the RRT (Appendix A) or by calling the Emergency Response Division of the U.S. EPA (202-260-2342).

The State OSCA licensed dispersants may be found in Appendix I or by calling the State OSPR representative on the RRT (Appendix A).

Decision: Can this oil be dispersed with an approved and available agent?

			Date	Time
❒	Yes	Go to **Box 3.**	………	….…...
❒	No	Go to **Box 1c**	**………**	**………**

Taken in part from Cawthron, 2000

Discussion Note 2.1 **OIL DISPERSIBILITY**

Three types of oils are typical of those produced or transported in California offshore waters: a) crude oils produced in California Outer Continental Shelf waters; b) oils imported from Alaska and foreign countries into California ports; and c) fuel oils that could be spilled from a variety of marine industrial activities (*e.g.*, fuel tanks from ships, cargoes of small tankers). Dispersants only work if the spilled oil has a relatively low viscosity at the time of treatment.

Appendices C.1 and C.2 show the California platform-produced oils and tankered oils, respectively.

Most oils produced from offshore platforms are heavy, and border on the range of oils that are considered to be difficult or impossible to disperse. The oils transported by tanker (1999-2001 data) include two-three dozen different types of oil (only the most common are listed in Appendix C.2). The most important is Alaska North Slope crude, which represents 50% of each annual total. Based on API gravity information, these oils appear to be dispersible when fresh.

- The most important criterion for dispersant use is whether the oil is dispersible.
- The best indication of oil dispersiblity is from specific oil weathering and dispersion data from field trials.
- Potential dispersibility can be *estimated* from physical properties of oils, under different oil weathering and spill scenarios (*e.g.*, ADIOS, Table 2.1 below). The ADIOS computer database predicts oil dispersion based on physical and chemical properties of spilled oil under specified spill conditions.
- Dispersant use should not be rejected exclusively on the basis of predictive models

Generally, if:

- Oil is able to spread on the water, it is likely to be dispersible.
- Viscosity is 2000 cSt, dispersion is probable.
- Viscosity is >2000 cSt, dispersion is possible.
- Viscosity is >5000 cSt, dispersion is possible with concentrated dispersant (*e.g.*, Corexit 9500).
- Sea temperature is >10º C below oil pour point, dispersion is unlikely.

Potential dispersion may also be assessed using tables in Appendix C.

Limitations of predicting dispersion:

- Using generic values of viscosity and/or pour point to predict dispersion (*e.g.*, ADIOS, Appendix tables C.3 and C.4) can underestimate the potential for oil to be dispersed.
- Most models are based on limited oil weathering, emulsification or dispersion data, therefore estimated windows of opportunity may be inaccurate.

Taken in part from Cawthron, 2000 and S.L. Ross, 2002

Table 2.1 **ADIOS (AUTOMATED DATA INQUIRY FOR OIL SPILLS) COMPUTER DATABASE**

Use the **DISPERSANT APPROVAL ASSESSMENT FORM** and the NOAA SSC (206-321-3320) for the information needed by ADIOS, or use the form below. The NOAA SSC should also be able to assist with ADIOS.

Copies of ADIOS are available from the NOAA website: http://response.restoration.noaa.gov/software/adios/adios.html

Oil/product name:	_____________		Wind speed:	_____________ (knots)
Amount spilled:	_____________	(gal or bbl)	Wave height:	_____________ (m)
Type of release:		Circle one	Water temp.:	_____________ (ºC)
❑ Instantaneous			Water salinity:	_____________ (ppt)
❑ Continuous				

Important limitations on the use of ADIOS: ADIOS predicts dispersibility based on estimates of oil properties (including emulsification) under different conditions. As emulsification data are scarce, **predicted rates of dispersion may be different than actual rates of dispersion**. ADIOS is intended for use with floating oils only, and does not account for currents, beaching, or containment of oil. ADIOS is unreliable for very large or very small spills. It is also unreliable when using very high or very low wind speeds in modeling the spill.

BOX 3 **ARE OCEANOGRAPHIC AND/OR WEATHER CONDITIONS POTENTIALLY CONDUCIVE TO DISPERSANT USE?**

Does the available technical information indicate that the existing oceanographic (*e.g.*, surface current direction and speed, wave and chop height) and weather (*e.g.*, wind direction and speed, visibility, ceiling height) conditions are suitable for a successful dispersant application?

Use the following resources:

❒ Information on the DISPERSANT PRE-APPROVAL ASSESSMENT FORM
❒ Consultation with the NOAA Scientific Support Coordinator (206-321-3320)
❒ Information resources and web sites noted in Appendix A
❒ Information from aerial overflights
❒ Information from ADIOS

Decision: Are ocean and weather conditions suitable for a dispersants application?

		Date	Time
❒ Yes	Go to **Box 4**.	……….	……...
❒ No	Go to **Box 1c**	……….	………

BOX 4 **IS THE SPILLED OIL WITHIN 3 MILES FROM SHORE, A STATE OR FEDERAL BOUNDARY OR WITHIN NMS BOUNDARIES?**

A full-page statewide nautical chart indicating the area three nautical miles from shore and the areas within National Marine Sanctuaries (Gulf of the Farallones, Cordell Banks, Monterey, Channel Islands) is in Chart 4.1 below. Regional charts, with dispersant approval zones noted, are in Appendix B.

Plot the position of the spill on the appropriate nautical chart, draw a circle around the spill source with a 10 nautical mile radius as a worst-case scenario for surface movement. Hash mark any area within the circle that is in waters 3 nautical miles from shore or within a National Marine Sanctuary. This is considered the dispersant operational area.

Decision: Is the spilled oil within an RRT Approval Required zone?

		Date	Time
❒ Yes	Go to **Box 5**.	……….	……….
❒ No	Pre-Approval may apply. Go to **Box 4a**.	……….	……….

BOX 4a **PRE-APPROVAL MAY APPLY; REFER TO THE PRE-APPROVAL PROCESS.**

The request for dispersant use may not require a case-by-case RRT approval and may fall within the parameters of the pre-approval guidelines for the use of dispersants in RRT Regional IX. Review the Pre-Approval Guidelines and begin the pre-approval process if appropriate.

BOX 5 **WILL DISPERSANT USE HAVE A NET ENVIRONMENTAL BENEFIT?**

Use the regional sensitive species and habitat information from the Net Environmental Benefit Analyses for each major coastal area in which dispersant use may have an impact.

Consider:

- ❒ The type and value of habitat potentially affected.
- ❒ The sensitivity of affected resources to oil, and to different oil response strategies.
- ❒ Natural recovery rates of affected species and habitats.
- ❒ Likely oil persistence and degradation rates with and without dispersant use.
- ❒ Potential oil toxicity on surface water species compared to water column and/or seafloor species.

Dispersant use is generally not appropriate in areas with limited water circulation and flushing, near aquaculture facilities, shellfish beds and fish-spawning grounds, and around seawater intakes.

Decision: Will the dispersant use have a net environmental benefit?

		Date	Time
❒ Yes	Go to **Box 6**.	……….	……….
❒ No	Go to **Box 1c**.	……….	……….

Discussion Note 5.1 **ASSESSING NET ENVIRONMENTAL BENEFIT**

The most important question to answer is: **Will dispersant use significantly reduce the impact of the spilled oil**?

- Rapid decisions on use are essential as dispersant must be applied quickly to be effective.
- Decision-makers must consider the various environmental, social, economic, political and cultural factors unique to each spill.
- Tradeoffs will be necessary, as no response is likely to satisfy all parties and protect all resources. The ecological impacts of oil are generally longer-lasting and more persistent than most other impacts.
- Ecological effects will be due primarily to the spilled oil. Dispersant applied at recommended rates is unlikely to cause significant adverse effects, even in multiple applications.
- Oil dispersed into greater than 10m or water will quickly dilute to levels where acute toxic effects are unlikely.
- Few acute toxic effects have been reported for crude oil dispersed into less than 10m of well-flushed water.
- Small spills of light fuels seldom require dispersant use.

BOX 5a **MARINE ANIMALS INFORMATION FROM AERIAL WILDLIFE SPOTTERS**

The FOSC can take additional information and advantage from the Aerial Wildlife Observers if they have been deployed (**Box 1b**), or information from the Wildlife Aerial Survey Form (Appendix D.9) available from other aerial spotters, or information from wildlife spotters (Appendix E.2) available to the FOSC from other data collection forms or notes used by those spotters. Any of these resources will provide real-time or near real-time information on marine seabird and mammal presence, and can guide the FOSC on dispersant application parameters that may minimize impacts to those resources.

BOX 5b **REGIONAL SENSITIVE SPECIES AND HABITAT INFORMATION FROM NEBA**

At the time of an actual oil spill or a decision to use chemical dispersants on the oil, marine species are expected to be on the water surface or in the upper water column. Before using chemical dispersants, the FOSC will have decided that there may be a net environmental benefit from their use. Information on regional sensitive species and habitat information from the Net Environmental Benefit Analyses (NEBA), summarized for each region in Appendix B, can help the FOSC determine which species might actually be in the area and scouted for by the aerial observers (**Box 1b** and **Box 8a**). This additional information can provide further validation and justification to a FOSC that impacts of chemical dispersant application will be minimized wherever possible, and net environmental benefit maximized.

BOX 6 **CAN DISPERSANT BE APPLIED SAFELY FROM AN APPROPRIATE PLATFORM?**

Use the information in the DISPERSANT APPROVAL ASSESSMENT FORM to evaluate which application platform(s) will be most effective, given the following particular considerations:

- The amount of oil spilled;
- The location of the operational area;
- The volume of available dispersants;
- The timeframe in which the required equipment can be on-scene.

Assume for planning purposes that the weather information on the DISPERSANT APPROVAL ASSESSMENT FORM will remain the same during the timeframe in which this decision is operating. At the earliest opportunity, contact the NOAA SSC (206-321-3320) for more detailed and updated weather information, but do not delay this decision process for the NOAA SSC weather input. Weather information may also be available from resources noted in Appendix A. See Appendix C for specific information on dispersant application platforms.

Decision: Is there an appropriate application platform for a dispersant operation?

	Yes	(Type)	No	Date	Time
C-130/ADDS Pack	☐		☐	……….	……….
DC-4	☐		☐	……….	……….
Other large multi-engine airplane	☐	……………………	☐	……….	……….
Cessna AT-802	☐		☐	……….	……….
Other single-engine airplane	☐	…………………	☐	……….	……….
Helicopter	☐	…………………	☐	……….	……….
Work boat	☐	…………………	☐	……….	……….
	Go to **Box 7**		Go to **Box 6a**		

Taken in part from Cawthron, 2000 and S.L. Ross, 2002

Discussion Note 6.1 **CURRENT LOGISTICS FOR A CALIFORNIA DISPERSANTS APPLICATION**

Use the information on the **DISPERSANT-APPROVAL ASSESSMENT FORM** to consider the following:

- ❒ Is the selected dispersant available in the quantity needed?
- ❒ Can the estimated "window of opportunity" for getting the dispersant on the oil be met?
- ❒ Can the dispersant and application resources get to the spill scene on time?
- ❒ Will there be enough daylight hours for an effective dispersant application?

Refer to Appendix C for more specific regional dispersant resource information.

BOX 6a **DISPERSANT OPERATIONS ON WEATHER STANDBY**

Consult with appropriate RRT IX members (USCG/District 11 Co-Chair, EPA, DOI, DOC and OSPR (See Appendix A for contact information) to notify them that dispersants are being considered, but delayed due to weather.

Decision: **Has the weather improved to the point where dispersants can be applied?**

		Date	Time
❒ Yes	Go to **Box 7**	……….	……….
❒ No	Continue to **reassess** (until/unless time window for successful application closed) <u>or</u> Go to **Box 6b**	……….	……….

BOX 6b **WEATHER UNLIKELY TO IMPROVE OR SUITABLE RESPONSE RESOURCES NOT AVAILABLE**

There will be spill situations where dispersant use may be appropriate but weather conditions and available resources will not allow dispersants to get on the oil within the appropriate weather window. In these cases, dispersant use will need to be abandoned and other response options considered instead.

	Date	Time
Go to **Box1b**	……….	……….

BOX 7 **DISPERSANT USE RECOMMENDATION FORWARDED BY THE FOSC TO THE RRT FOR REVIEW AND APPROVAL**

Once the FOSC has completed the dispersant approval form, worked through each decision point identified in the dispersant use flow chart and completed the dispersant decision summary and a decision for dispersant use generated, the FOSC will forward a request, along with any other requested data, to the RRT via a phone conference. Based on the information provided, the RRT will provide an approval/disapproval decision for dispersant use within 2 hours of the request.

A dispersant use approval will be made with the concurrence of the U.S. Environmental Protection Agency and the U.S. Coast Guard representatives to the RRT and the State of California, and in consultation with the U.S. Department of Commerce and U.S. Department of the Interior natural resource trustees.

BOX 8 **DISPERSANT USE APPROVED BY THE RRT**

DISPERSANTS APPROVED FOR USE BY THE FOSC NEED TO BE APPLIED USING THESE RRT IX GUIDELINES AS WELL AS ANY CASE-SPECIFIC GUIDELINES ISSUED BY THE RRT AS PART OF THE APPROVAL:

- ❒ The SMART controller/observer should be over the spray site before the start of the operation. If possible, a DOI/DOC-approved marine mammal/turtle and pelagic/migratory birds observation specialist will accompany the SMART observer, but in any event, operations will not be delayed for these individuals.
- ❑ Dispersants cannot be applied to any diesel spill in the San Diego Area Contingency Plan area.
- ❒ Personnel protective equipment for personnel on-site will conform to the appropriate dispersant's Material Safety Data Sheet (MSDS).
- ❒ Dispersant application aircraft will maintain a minimum 1000-foot horizontal separation from rafting flocks of birds. Caution will be taken to avoid spraying over marine mammals and marine turtles (see Appendix A for resource agency contact information).
- ❒ If the dispersant application platform is a boat:
    - The following ASTM standards apply to systems involving spray arms or booms that extend over the edge of the boat and have fan-type nozzles that spray dispersant in a fixed pattern:
        - ASTM F 1413-92: Standard Guide for Oil Spill Dispersant Application Equipment: Boom and Nozzle Systems
        - ASTM F-1460-93: Standard Practice for Calibrating Oil Spill Dispersant Application Equipment Boom and Nozzle Systems
        - ASTM F 1737-96: Standard Guide for use of Oil Spill Dispersant Application Equipment During Spill Response: Boom and Nozzle Systems.
    - Boat-based systems using a fire monitor and/or fire nozzle shall avoid a straight and narrow "firestream" flow of dispersant directly into the oil. There are no applicable ASTM standards for these systems at this time (December 2003).

BOX 8a **INITIATE *PUBLIC COMMUNICATIONS PLAN***

Once a decision to use dispersants is made, it is critical that a public communications plans be implemented (Appendix F). The general public as well as stakeholders must be made aware of the decisions to utilize dispersants and a mechanism must be put into to for reliable and continuous updates (Appendix F.3.).

An initial press conference should be held which outlines the decision to utilize dispersants, provides background and scientific information as well as any environmental and safety considerations. Press packet information can be found in (Appendix F.1)

A town hall meeting should be scheduled as soon as to provide a mechanism for sharing of information as well as addressing public concerns and fears. Appendix (F.2) provides guidelines for preparation of a town hall meeting. Areas that must be adequately addressed include the following;

- Seafood tainting concerns posed by the use is dispersants (Appendix G).
- Risk communication (Appendix F.2)
- Net environmental benefit analysis conducted and species of special concern.
- Monitoring policies established for the spill.

BOX 8b **CONSULT SEAFOOD TAINTING PLAN**

- Refer to Appendix G for key points to consider regarding Seafood tainting, as well as information on accessing NOAA and State of California resources for assessing the tainting risk

BOX 9 **APPLY DISPERSANTS**

- ❑ Using the information on <u>estimated oil spill volume</u> from the DISPERSANT PRE-APPROVAL ASSESSMENT FORM and Discussion Note 9.1 below to:

  - Determine the dispersant application ratio (usually 1:20), and
  - Calculate the volume of dispersant required (Appendix D.1).

- ❑ Record the details on the Dispersant Application Summary Form (Appendix D.2);
- ❑ Mobilize application team;
- ❑ ❒ If not already done, mobilize SMART. Some blank SMART forms are included in Appendix D for use by other trained professionals, if appropriate and when approved by the FOSC.
- ❑ Inform RRT (see Appendix A for contact information).

Decision: Dispersants applied?

			Date	Time
❑	Yes	Go to **Box 10**.	....	....
❑	No	Explain.	....	....

In part from Cawthron, 2000

Discussion Note 9.1 GENERAL APPLICATION INFORMATION

- The FOSC has final responsibility for operational aspects of dispersant applications.
- Dispersant must only be applied by experienced spray applicators.
- Dispersant must be applied in accordance with manufacturer instructions, unless approved otherwise by the FOSC.
- The persons applying dispersant are responsible for the calibration and operation of the spraying system, and the safety and maintenance of the application platform.
- Droplet size is the key variable influencing dispersant effectiveness. Undersized droplets (*e.g.*, fog or mist) will be lost through drift and evaporation. Oversized droplets will punch through the oil and be lost in the water column.
- Dispersants pre-diluted in water are less effective than undiluted dispersant.
- Only undiluted concentrate dispersant is applied from aircraft. Dispersant should, where possible, be applied into the wind and parallel with the slick.
- Dispersant should be applied in a methodical and continuous manner to ensure the entire target area is treated.
- Spraying effort should concentrate on the thickest sections, and/or the leading edges, of oil that threaten sensitive areas.
- Thick portions of the slick may require several applications.
- Oil sheen (oil less than approximately .001 inch or .02 mm thick) should not be sprayed with dispersant.

Regarding the relationship between Dispersant-to-Oil Ratio (DOR) and the concentration of oil being treated:

- Regardless of DOR ratios suggested by dispersant manufacturers, there are may factors that influence dispersability (*e.g.*, oil characteristics, degree of weathering, water salinity, sea state) that may make it very difficult for any "user" to select an appropriate DOR for the conditions faced on the day of a specific spill
- he variability of slick thickness (or oil concentration) is such that one can never really characterize the actual oil concentration for more than a few seconds within the speed and swath constraints of a particular application system.
- With most application systems, one is usually overdosing and underdosing as the system moves through light, heavy and sometimes "no" oil on the water surface.
- The best estimate of the average oil thickness (or average volume of oil per unit are) must be used.
- Crude oil that is dark in color and thick enough to merit any response is generally between .001 inch (.017 mm) thick and .01 inch (0.25 mm). Crude oil emulsion begins to form at .01 inch (0.25 mm), and tar balls at .1 inch (2 mm). See Appendix D.1 for more information.
- Given that precise spray parameters are extremely difficult to achieve, dispersant applicators generally use about 5 gallons of dispersant per acre on their first run. This is a "middle-of-the-road" concentration in most situations of 2 to 3 barrels of oil per acre (or ~ 100 gallons per acre) following the initial rapid spreading phase. With a common accepted DOR of 1:20, the recommended dosage would be 1/20 x 100, or 5 gallons of dispersant per acre.
- Area, volume and thickness can be related with the following expression:

$$\mathbf{10^4 \times Area\ (hectare) \times Thickness\ (mm) = Volume\ (liters)}$$

or

$$\mathbf{Volume\ (liters/Area\ (hectares) = 10^4 \times Thickness\ (mm)}$$

►To convert liters/hectare to gallons/acre, multiply by 0.107
►To convert liters/hectare to gallons/square kilometer, multiply by 26.42

►These values (in any units) multiplied by the DOR (as a fraction, e.g., 1:5 = 1/5 or .2) will then yield the Desired Dosage (in those units) for that value of DOR.

- Refer to Appendix D.1 for some pre-calculated values.

From Cawthron, 2000 and Al Allen (Spilltec), 2003 personal communication

Discussion Note 9.2 **AERIAL APPLICATION**

This general aerial application guide is intended simply to highlight key issues. The FOSC will coordinate and oversee operational aspects of aerial dispersant applications.

- Aircraft applications should always include pump driven spray units.
- Dispersant droplet size should be between 400 and 1000 microns.
- Commercial aircraft spray nozzles generally range between 350 and 700 microns.
- 1000 micron spray nozzles may be needed for use on viscous oils.
- Nozzles should achieve an application rate of between 5.3 gallons per acre (1:20 ratio)
- Spray nozzles should be installed to discharge directly aft.
- Underslung buckets on helicopters should be mounted so the pilot can see the ends of the spray booms in flight.
- The altitude of the aircraft should be as low as possible.

From Cawthron, 2000

Discussion Note 9.3 **BOAT APPLICATION**

- Spray booms should be mounted as far forward as possible t prevent oil being moved aside by the bow wave before being sprayed. This then utilizes the mixing energy of the bow wave to break up the oil.
- Spraying systems should be set so that the spray pattern is flat, striking the water in a line perpendicular to the direction of the boat's travel.
- The fan-shaped sprays from adjacent nozzles should be set as low as possible, overlapping just above the oil/water surface, with the inboard spray striking the hull just above the waterline.

Undiluted dispersants

- Air blast sprayers and modified spray pumps can be used to apply undiluted concentrated dispersants and conventional dispersants.
- Treatment rate is usually constant and determined by nozzle size and spray pressure.
- Calibration and use of an appropriate droplet size is critical toe effective applications.

Pre-diluted dispersants

- Concentrated dispersants can be applied after pre-dilution in seawater, but will be less effective.
- The dispersant : water ratio should be equal to, or greater than, 10%
- Applications through ship's fire-fighting equipment are controlled by opening or closing the dispersant supply. Vessel speed is used to control the treatment rate.
- Dual pump systems for dispersant and seawater supplying spray booms allow the dilution rate to be adjusted.
- Boat speed is the main determinant of dispersant dose rate (reduce boat speed to increase the dose rate).
- Boat speed should be in the order of 5 knots for fresh spills of liquid crude or fuel oil, which assumes that the oil has spread to 0.1 mm thick.
- With reduced boat speeds, the required application rate per acre or km^2 can be maintained by reducing pump speed.

From Cawthron, 2000

BOX 10 **IS THE DISPERSANT EFFECTIVE?**

- ❑ Acquire information from dispersant monitoring team (SMART team or other FOSC-designated monitors).
- ❑ Review dispersant monitoring results after each dispersant application.
- ❑ Determine if dispersant application is effective.
- ❑ Determine if chemical dispersion is significantly greater than natural dispersion.
- ❑ Assess whether changing application parameters could make the application more effective.

Decision: Is the dispersant effective?

		Date	Time
❑ Yes	Go to **Box 11**	....	....
❑ No	❑ See Discussion Note 10.2 and return to **Box 9**, or	....	....
	❑ Go to **Box 12**	....	....

From Cawthron, 2000

Discussion Note 10.1 **ASSESSING DISPERANT EFFECTIVENESS**

- Dispersant applications must be monitored to confirm whether or not dispersant use is effective, and to determine the fate and transport of treated oil.
- Dispersant applications should not be delayed simply because monitoring is not in place.
- Visual observation is the minimum level of monitoring. Observations teams may use the forms in Appendix D.
- There will be very few instances where a dispersant application is possible but visual monitoring is not.
- Because dispersed oil plumes are often highly irregular in shape and thickness, it can be difficult to accurately estimate dispersant efficiency.
- The appropriate dispersant application dose depends on the oil thickness (see Appendix D.1 for common dose rates based on oil thickness). Slicks are generally not of uniform thickness, and it is not always possible to distinguish among thicker and thinner portions of the same slick. It is therefore possible to apply too much or too little dispersant to some parts of a slick. Because over- and under-dosing can lead to variations in effectiveness, these variations should be noted.
- On-site monitoring of oil dispersed in the water column should support visual monitoring whenever possible. See Appendix D for additional information and forms.
- Decisions to terminate operations due to poor effectiveness should ideally be based on on-site monitoring results.
- A visible coffee-colored cloud in the water column indicates the dispersant is working.
- A milky-white plume in the water column can indicate excessive dispersant application.
- When dispersant is working, oil remaining on the water surface may also change color.
- A difference in the appearance of treated and untreated slicks indicates dispersion is likely.
- Absence of a visible cloud in the water column makes it difficult to determine whether the dispersant is working. When the water is turbid, you may not be able to see a plume. Oil remaining at the surface and sheens can also obscure an ability to see oil dispersing under the slick.
- Successful dispersion can occur with no visible indication of dispersion.
- A subsurface plume may not form instantly once dispersant has been applied. In some cases (*e.g.*, emulsified oil) it can take several hours for a plume to form. In other cases, a visible plume may not form, and you may wish to use sampling to learn whether dispersion has occurred.
- Boat wakes may physically part oil, falsely indicating successful dispersion. Mechanically dispersed oil will re-coalesce and float to the surface.
- Dispersants sometimes have a herding effect on oil after initial applications, making a slick appear to be shrinking when, in fact, the dispersant is "pushing" the oil together. The effect results from the surfactants in the dispersant, which causes a horizontal spreading of thin oil films. This can cause parts of a slick to seem to disappear from the sea surface for a short time.

From Cawthron 2000 and NOAA Oil Spill Job Aids

Discussion Note 10.2 **WHEN DISPERSANT IS NOT EFFECTIVE**

If monitoring shows dispersion does not appear effective, review all aspects of the application and monitoring for possible reasons why. Aspects to consider include:

- Dispersant formulation
- Application rations (increase or decrease oil: dispersant ratio)
- Application methods
- Monitoring methods
- Interpretation of monitoring results
- Oil weathering
- Weather conditions

From Cawthron, 2000

BOX 11 **IS ONGOING DISPERSANT USE JUSTIFIED AND SAFE?**

All of the following must apply to justify ongoing dispersant use:

- ❑ The spill can be chemically dispersed with an approved and available agent (see **Box 2** and Appendices H and I);
- ❑ Oceanographic and weather conditions are potentially conducive to dispersant use (see **Box 3** and DISPERSANT PRE-APPROVAL ASSESSMENT FORM);
- ❑ The dispersant will have a net environmental benefit (see **Box 5**);
- ❑ The dispersant can be applied safely (see **Box 6**), with suitable weather (**Box 6a**) and available resources (**Box 6b**);
- ❑ The dispersant is effective (see **Box 10**).

Decision: Continue with dispersant use?

			Date	Time
❑	Yes	Go to **Box 9**	....	....
❑	No	Go to **Box 12**	....	....

THERE WILL BE A POINT WHEN THE USE OF DISPERSANT IS NO LONGER EFFECTIVE.

BOX 12 **DO NOT USE DISPERSANT**

Dispersant should not be used if **any** of the following apply:

- ❑ The spill cannot be chemically dispersed with an approved and available agent (see **Box 2** and Appendices H and I);
- ❑ Oceanographic and weather conditions are not potentially conducive to dispersant use (see **Box 3** and DISPERSANT PRE-APPROVAL ASSESSMENT FORM);
- ❑ The dispersant will not have a net environmental benefit (see **Box 5**);
- ❑ The dispersant cannot be applied safely (see **Box 6**), with suitable weather (**Box 6a**) or available resources (**Box 6b**);
- ❑ The dispersant is not significantly more effective than natural dispersion or other response options (see **Box 10**).

IF DISPERSANT USE IN CONSIDERED INAPPROPRATE, CONSIDER OTHER RESPONSE OPTIONS.

Go to **Box 1a**.

APPENDIX K

REGIONAL IX DISPERSANT USE POLICY AND PLANNING DOCUMENT

Note: Section numbering refers to that used in the SF-Bay Delta Area Contingency Plan

3.3.4 USE OF DISPERSANTS IN U.S. REGION IX

Dispersants have been proven to be an excellent first strike method to minimizing the impacts of an oil spill. A quick response to an oil spill incident using dispersants may greatly reduce the need for mechanical recovery methods, storage, transportation and disposal. Timely dispersal of an oil spill may greatly reduce the possibility and extent of shoreline impacts, as well as greater environmental damage. The following guidelines explain the actions the On-Scene-Coordinator (OSC) shall take in the event of an oil spill within his/her respective area of responsibility (AOR).

Each of the six coastal Area Committees (AC) within the Region IX will identify areas for which they are responsible and designated them either "Dispersants Are Pre-Approved", Dispersants Are Pre-approved With Consultation", or RRT Approval Required". Each AC shall identify any pre-condition for each designation as outlined in Section 4551 of the Applicable Area Contingency Plan (ACP).

The Area committee shall provide to the RRT as part of their completed dispersant use plans:

a. Completed ICS-204 including all names and titles of pre-designated personnel;
b. Dispersant monitoring plan

3.3.4.1 If a spill occurs in a location designated "dispersants are pre-approved", and if all dispersant use criteria have been met, the OSC will:

a. With the recommendation of the unified Command (UC) Planning Section Chief, activate the pre-identified dispersant resources for the area of the incident for a quick response (within 4 hrs);
b. Notify Natural Resource Trustee Representatives per the applicable ACP notification process (Ref. 3.3.4.4).

3.3.4.2. If a spill occurs in a location designated as "Dispersants Are Pre-Approved With Consultation", the OSC will:

a. Gather all supporting data necessary to determine if dispersant use is appropriate;
b. Contact the designated natural Resource Trustee Representative (refer to ACP) within the respective Area Committee with a request for all data to the given location (e.g.: biological data such as species seasonal migration, spawning, etc) which will assist the OSC in making a dispersant use decision;
c. Wait for approval/denial of dispersant use;
d. Activate the pre-identified dispersant resource(s) for the area of the incident for a quick response (within 4 hrs);
e. Notify Natural Resource Trustee Representative per the applicable ACP notification process (Ref 3.3.4.4);
f. If consultation does not result in a recommendation to disperse, the OSC shall activate the RRT for approval in accordance with CFR 300.910 (b)

3.3.4.3 If a spill occurs in a location designated "RRT Approval Required", prior to any dispersant use, the On-Scene Coordinator shall:

a. Contact the U.S. Coast Guard RRT Co-chair and provide all necessary data concerning the affected location;
b. The U.S. Coast guard RRT Co-chair shall contact the EPA Co-chair and all RRT IX Resource Trustees as noted in the existing "Dispersant Use Quick Approval Process (QAP)(ACP Section 4551) t discuss and provide a decision to the OSC in a timely manner (2hrs or less) of the OSC's request.

3.3.4.4 Notification of RRT

The RRT shall always be notified of dispersant use within Federal waters of California. The following provides guidance on notification requirements in each designated area:

a. DISPERSANTS ARE PRE-APPROVED. The U. S. Coast Guard RRT Co-chair will communicate this information in a timely manner to the U.S. EPA Co-chair and to the RRT Natural Resource Trustees.

b. DISPERSANTS ARE PRE-APPROVED WITH CONSULTATION. After consultation has yielded a recommendation to use dispersants, the RRT co-chair shall be notified of dispersant use by the UC following a dispersant use decision. The U.S. Coast Guard RRT Co-chair will then communicate this information in a timely manner to the U.S. EPA Co-chair and to the RRT Natural Resource Trustees.

c. RRT APPROVAL IS REQUIRED: Once approval for dispersant use has been granted the U.S. Coast guard RRT Co-chair will keep the appropriate members of the RRT apprized of the dispersant use activities.

4.6 DISPERSANT USE PLANNING PROCESS

The use of dispersants in Federal marine waters off the coast of California requires detailed foresight and planning. In an effort to expedite a decision to use dispersants and reduce first strike response time, Area Committees shall designate specific areas within their responsibility as either "Dispersant approved", " Dispersant Approved with Consultation", or "RRT Consultation Required". These efforts shall be accomplished within the six California Area Committees using the regional knowledge and expertise of the Area Committee members.

The following guidance is provided to ensure an expeditious dispersant use process is developed and approved for use within Federal marine waters off shore of California [33 CFR 2.05-1 thru 35], excluding state waters within three miles offshore as defined in [43 USC Section 1312]

4.6.1 The RRT Region IX Natural Resource Trustees shall identify a representative(s) to each of the six California Area Committees to assist with dispersant use planning [40CFR300.115(g)]. These representatives may serve on subcommittees and/or be available to provide professional expertise to the Area committee in the development of their dispersant use plan.

4.6.2 The Area Committees shall identify locations within their respective areas where:

a. DISPERSANTS ARE PRE-APPROVED. The Area Committee determines that reduced threat to public health or natural resource damage will result form the use of dispersants in that particular area; *benefits outweigh the negative impacts*. The OSC will make the decision of whether or not to utilize dispersants in accordance with the Area Contingency Plan (40CFR300.910).

b. DISPERSANTS ARE PRE-APPROVED WITH CONSULTATION. The Area Committee determines there is potential for natural resource damage involved with the use of dispersants in a particular area at given times (*i.e*. possible migratory species, spawning, etc. within the geographic area). OSC shall request timely (2hrs or less) technical consultation from the pre-identified natural Resource Trustee Representative.

c. RRT APPROVAL IS REQUIRED: The OSC is required to obtain approval prior to dispersant use from RRT Co-chair, and as appropriate, the concurrence of the RRT representatives from the state with jurisdiction over the navigable waters threatened by the release or discharge, and in consultation with the Department of Commerce and Interior natural resource trustees, when practicable [40CFR300.910(b)]. Quick Approval Process is exercised (see California ACP section 4551)

4.6.3 The Natural Resource Trustee representative to the RRT will provide a list of agency representatives to the Area Committee to be notified when the OSC uses dispersants.

4.6.4 Each Area committee in California will submit dispersant use plans to RRT IX to review, approve, disapprove or approve with modification [40CFR300.910(a)].

4.6.5 Upon approval of the Area Committee dispersant use plan, the Federal On-Scene Coordinator may implement the approved dispersant use plan [40CFR300.910(a)].

4.6.6 The RRT will provide training program guidelines for dispersant deployment in Region IX.

4.6.7 Area Committee chairs will provide a training program for their Area Committee members involved in dispersant deployment. The Federal On-Scene Coordinator will exercise major components of this plan annually per the Area Contingency Plan (consistency is needed throughout Region IX).

4.6.8 The RRT Co-chairs will provide the RRT membership with appropriate dispersant training.

4.6.9 The RRT members are responsible for remaining apprised of Area Committee progress and activities in dispersant use planning.

4.6.10 Substantive revisions will be incorporated to the dispersant use plans upon review by the RRT.

4.6.11 The Area Committee locates all dispersant products and equipment available within their area for effective deployment (4hrs or less). This information will be placed in section 5000 (logistics) of the Area Contingency Plan.

4.6.12 The Area committee will utilize Special Monitoring of Applied Response Technologies (S.M.A.R.T.)(ref. CA ACP Section 4560) to provide the UC real-time feedback on the efficacy of the dispersant application, Response Trustees can then use other monitoring tools for follow up after dispersant application use to endure the goal of measuring environmental tradeoff's is met.

4.6.13 The Area Committee annually reviews the dispersant plan.

APPENDIX L

RESULTS OF REVIEWS WITH OTHER AGENCIES

L.1 U.S. Fish and Wildlife Service (Endangered Species Act)

Underway. Insert when completed

L.2 National Marine Fisheries Service (Endangered Species Act, Marine Mammal Protection Act, Essential Fish Habitat)

Insert when letter completed.

L.3 California Coastal Commission (Coastal Zone Management Act)

Occurs at end of process. Insert when completed.

APPENDIX M

UNIT CONVERSIONS

Volume

1 U.S. Gallon (gal) = 231 in^3 = 0.1337 ft^3
1 barrel(s) (bbl) = 42 U.S. gal = 5.615 ft^3
1 bbl = 158.97 liter (L) = 0.159 m^3
1 U.S. gal = 3.785 L
1 L = 0.26 gal
1 tonne of oil = 1000 L = 1m^3 = ~ 264 gal
1 m^3 = 6.29 bbl = 264.2 gal
1 ft^3 = 0.0283 m^3 = 7.48 gal
1 m^3 = 10^6 cm^3 = 10^3 L
1 Imperial gal = 1.2 U.S. gal
1 U.S. gal = 0.83 Imperial gal

Length

1 inch = 2.54 cm
1 ft = 30.38 cm
1 ft = 0.3048 m
1 m = 3.2808 feet
1 statute mile = 0.87 nautical mile (nm)
1 mile = 1610 m = 5280 ft
1 nm = 6076 feet
1 km = 0.54 nm
1 nm = 1.852 km = 1852 m
1 nm = 1.15 statute miles
1 micron = m x 10^{-6} = mm x 10^{-3}
1 fathom (6 ft) = 1.829 m
1 m = 0.547 fathoms

Volume Rate

L/hr x 0.0063 = bbl/hr
L/hr x 0.0044 = gpm
tonnes/hr (or m^3/hr) x 4.4 = gpm
tonnes/hr x 6.3 = bbl/hr
bbl/hr x 0.7 = gpm
L/sec x 15.9 = gpm
gpm x 34.29 = bbl/day
m^3/hr x 16.7 = L/min
L/min x 0.06 = m^3/hr
gpm x 3.78 = L/min
bbl/day x 0.11 = L/min
bbl/day x 0.0292 = gpm

Distance Rate

1 knot = 1.69 ft/sec
1 knot = 1.94 m/sec = 1.13 miles/hr
ft/sec x 0.593 = knots
m/sec x 1.94 = knots
miles per hour (mph) x 1.5 = ft/sec
knots (kts) x 51.4 = cm/sec

Area

1 hectare = 10000 m^2 = 100m^2
1 acre = 43560 ft^2 = 0.4047 hectares = 247 km^2
1 acre = 4047 m^2
1 hectare = 2.471 acres
1 ft^2 = 0.0929 m^2
1 $mile^2$ = 2.59 km^2
1 nm^2 = 847 acres

Weight

1 pound (lb) = 0.45 kilograms (kg)
1 kg = 2.2 lb
lb/ft x 1.48 = kg/m
kg/m x 0.672 = lb/ft
1 metric ton = 1000 kg (~ 1 long ton)

From ExxonMobil , 2000

APPENDIX N

ABBREVIATIONS AND ACRONYMS

AC	Area Committee
ACP	Area Contingency Plan
ADP	Area Dispersant Plan
ADIOS	Automated Data Inquiry for Oil Spills
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
AZ	Arizona
CA	California
CDNMS	Cordell Bank National Marine Sanctuary
CCC	California Coastal Commission
CDFG	California Department of Fish and Game
CDP	California Dispersant Plan
CINMS	Channel Islands National Marine Sanctuary
COTP	Captain of the Port
CZMA	Coastal Zone Management Act
DOC	Department of Commerce
DOI	Department of Interior
DUP	Dispersant Use Policy
EADC	Emergency Aerial Dispersant Consortium
EFH	Essential Fish Habitat
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
FOSC	Federal On –Scene Coordinator
GFNMS	Gulf of the Farallons National Marine Sanctuary
GIS	Geographic Information System
GPS	Global Positioning System
HCPB	Habitat Conservation Planning Branch
LA	Los Angeles
MBNSM	Monterey Bay National Marine Sanctuary
MMPA	Marine Mammal Protection Act
MSDS	Material Safety Data Sheet
NCP	National Contingency Plan
NEBA	Net Environmental Benefit Analysis
NMFS	National Marine Fisheries Service
NMS	National Marine Sanctuary
NOAA	National Oceanic and Atmospheric Administration
NRC	National Response Center or National Response Corporation
OCS	Outer Continental Shelf
OSCA	Oil Spill Cleanup Agent
OSPR	Office of Spill Prevention and Response
OSRO	Oil Spill Response (or Removal) Organization
PPE	Personal Protective Equipment
PST	Pacific Standard Time
RCP	Regional Contingency Plan
RRT	Regional Response Team
SCB	Southern California Bight
SMART	Special Monitoring of Advanced Response Technologies
SSC	Scientific Support Coordinator
UHF	Ultra High Frequency
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
VHF	Very High Frequency

avg	average
C	Centigrade
cSt	centistoke
bbl	barrel or barrels
F	Fahrenheit
ft	foot or feet
gal	gallon or gallons
gpm	gallons per minute
h	height
hr or hrs	hour or hours
Ha	hectare
km	kilometer
kt or kts	knot or knots
L	liter
m	meter
mm	millimeter
mph	miles per hour
nm	nautical mile
ppm	parts per million
ppt	parts per thousand
$>$	greater than
$<$	less than
$\geq$	greater than or equal to
$\leq$	less than or equal to

APPENDIX O

GLOSSARY

ADIOS

Automated Data Inquiry for Oil Spills. A NOAA computer database listing the characteristics of crude oils and refined products, and predicting expected characteristics and behavior of oil spilled into the marine environment.

API gravity

A scale for measuring fluid specific gravities based on an inverse relationship with specific gravity.

Black oil

A black or very dark brown layer of oil, sometimes with a latex texture. Depending on the quantity spilled, oil tends to quickly spread out over the water surface to a thickness of about 1 millimeter (0.04 inches). Can look like kelp and other natural phenomena. From the air, it is impossible to tell how thick a black oil layer is.

Brown oil

Water-in-oil emulsion. Thickness typically is 0.1 to 1.0 millimeters, but will vary depending on wind and current conditions. Usually has a heavy or dull sheen. Brown oil can be easily confused with algal scum collecting in convergence lines, algae patches, or kelp.

Centistoke (cSt)

A unit of measurement used in defining the kinematic viscosity of a fluid.

Chemical dispersant

A chemical formulation containing surface active agents (surfactants) that lower the surface tension between oil and water, promoting the formation of oil droplets and reducing the tendency of oil to stick to other droplets or surfaces, thereby enhancing dispersion into the water column.

Clean up

Actions taken to prevent further oil releases, protect areas from oil damage, mitigate oil effects (*e.g.*, through deflection, containment, collection, chemical dispersion, or bioremediation), and clean up of oil-contaminated areas and wildlife where monitoring shows a net environmental benefit in doing so.

Coastal waters

The territorial sea from the shoreline high water mark and then offshore to 12 nautical miles.

Continental waters

The coastal waters (high water mark to 12 nautical miles offshore) and the Exclusive Economic Zone (12 to 200 nautical miles offshore), and all water over the continental shelf.

Contingency plan

An action plan prepared in anticipation of an oil spill for a site or region, containing guidelines and operating instructions to facilitate efficient and effective clean up operations, and to protect areas of biological, social and economic importance. Contingency plans affecting response planning and response in California include Area Contingency Plans (federally directed by the Oil Pollution Act of 1990, covering marine response in federal waters (3 – 200 nautical miles from shore) throughout California, and with the greatest regional detail), the State Contingency Plan (California state directed by the Lempert-Keene-Seastrand Act, covering California response in state waters (0-3 nautical miles from shore), the Regional Contingency Plan (federally directed and managed by the Region IX Regional Response Team, covering marine and inland response in several western states), and the National Contingency Plan (federal directed and covering national response in marine and inland waters).

Convergence line
A line on the water surface where floating objects and oil collect. A convergence can be the interface between two different types or bodies of water, or it can be caused by a significant depth change, tidal changes, or other common phenomena. Convergences are common in the marine environment.

Dispersion
The breaking up of an oil slick into small droplets that are mixed into the water column by breaking waves and other sea surface turbulence.

Emulsification
The formation of a water-in-oil mixture. Different oils exhibit different tendencies to emulsify, and emulsification is more likely to occur under high energy conditions (strong winds and waves). An emulsified mixture of water in oil is commonly called “mousse”; its presence indicates a spill that has been on the water for some time.

Entrainment
The loss of oil from containment when it is pulled under a boom by a strong current. Entrainment typically occurs from booms deployed perpendicular to currents greater than 1 knot (0.5 meters per second).

Flash point
(see volatility)

Mousse
An emulsified mixture of water in oil. Mousse can range in color from dark brown to nearly red or tan, and typically has a thickened or pudding-like consistency compared to fresh oil. Incorporation of up to 75 percent water into the oil will cause the apparent volume of a given quantity of oil to increase by up to four times.

Pancakes
Isolated, roughly circular patches of oil ranging in size from a few feet across to hundreds of yards (or meters) in diameter. Sheen may or may not also be present.

Persistent oil
Oils and petroleum products such as crude oils, fuel oils and lubrication oils that, when spilled, remain in a residual form in the environment for an appreciable period.

Plume
Oil that is dispersing into the water column as a cloud of small droplets.

Pour point
The temperature below which oil will not flow.

Recoverable oil
Oil in a thick enough layer on the water to be recovered by conventional techniques and mechanical equipment. Only black or dark brown oil, mousse, and heavy sheens (which are dull brown in color) are generally considered to be thick enough to be effectively recovered by skimmers.

Sheen

A very thin layer of oil floating on the water surface. Sheen is the most commonly-observed form of oil during the later stages of a spill. Depending on thickness, sheens range in color from dull brown for the thickest sheens to rainbow, gray, silver and near-transparent in the case of the thinnest sheens.

- A <u>light sheen</u> is almost transparent, and is sometimes confused with windrows and natural sheen resulting from biological processes.
- A <u>silver sheen</u> is a slightly thicker layer of oil that appears silvery or shimmers; occasionally called gray sheen.
- A <u>rainbow sheen</u> reflects colors.

Slick

Oil spilled on the water, which absorbs energy and dampens out surface waves, making the oil appear smoother – or slicker – than the surrounding water.

SMART

Special Monitoring of Applied Response Technologies. A cooperatively designed monitoring program for *in situ* burning and dispersants. SMART relies on small, highly mobile teams to collect real-time data, which are subsequently channeled to the Unified Command to address critical questions, such as whether dispersants are effective in dispersing the oil.

Specific gravity

The ratio of the mass of oil to the mass of freshwater, when both are of the same volume and temperature.

Streamers

A narrow line of oil, mousse, or sheen on the water surface, surrounded on both sides by clean water. Streamers result from the combined effects of wind, currents, and/or natural convergence zones. Often, heavier concentrations of mousse or sheen will be present in the center of a streamer, with progressively lighter sheen along the edges. Streamers are also often called “fingers” or “ribbons”.

Tarballs

Weathered oil that has formed pliable balls or patches that float on the water. Tarballs can range in diameter from a few millimeters (much less than an inch) to a foot (0.3 meters). Sheen may or may not be present, depending on how weathered or hardened the outer layer of the tarball is.

Tarmats

Non-floating mats of oily debris (usually sediment and/or plant matter) that are found on beaches or in shallow water just offshore.

Unified Command

Representatives of the spiller, the federal government, and state government, who are collectively in charge of the spill response. For California marine spills, the federal representative is the U.S. Coast Guard and the state representative is the California Department of Fish and Game Office of Spill Prevention and Response.

Viscosity

An oil’s internal resistance to flow. Highly viscous oil will not flow easily.

Volatility

A property of a liquid that has a low boiling point and a high vapor pressure at ordinary pressures and temperatures.

Water-in-oil emulsion

(see mousse)

Weathering

A combination of physical and environmental processes, such as evaporation, dissolution, dispersion, and emulsification, which act on spilled oil to change its physical properties and composition.

Window of opportunity

The period of time available for undertaking a particular response. For example, the application of dispersant before the oil emulsifies to a stage where dispersant becomes ineffective.

Windrows

Streaks of oil that line up in the direction of the wind. Windrows typically form early during a spill when the wind speed is at least 10 knots (5.1 meters per second). Sheen is the form of spilled oil that most frequently forms windrows.

APPENDIX P

NALCO/EXXON ENERGY CHEMICALS, L.P.

MATERIAL SAFETY DATA SHEET

PRODUCT

EC9527A COREXIT 9527

Emergency Telephone Number
Medical (800) 462-5378 (24 hours) (800) I-M-ALERT

SECTION 01 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

TRADE NAME: EC9527A COREXIT 9527
DESCRIPTION: A blend of oxyalkylate polymers, organic sulfonic acid salt, substituted fatty ester, and glycol ether

NFPA 704M/HMIS RATING 2/2 HEALTH 2/2 FLAMMABILITY 0/0 REACTIVITY 0 OTHER
0=Insignificant 1=Slight 2=Moderate 3=High 4=Extreme

SECTION 02 COMPOSITION AND INFORMATION ON INGREDIENTS

Our hazard evaluation has identified the following chemical ingredient(s) as hazardous under OSHA's Hazard Communication Rule, 29 CFR 1910.1200. Consult Section 15 for the nature of the hazard(s).

INGREDIENT(S)	CAS #	APPROX.%
2-Butoxyethanol	111-76-2	20-40

SECTION 03 HAZARD IDENTIFICATION

EMERGENCY OVERVIEW:
WARNING! Causes irritation to skin and eyes. Combustible. May be harmful if inhaled, swallowed or absorbed through the skin. Avoid prolonged or repeated breathing of vapor. Do not get in eyes, on skin, or on clothing. Wear goggles and face shield when handling. Use with adequate ventilation. Do not take internally. Keep away from heat and open flame. Keep container closed when not in use.

Empty containers may contain residual product. Do not reuse container unless properly reconditioned.

PRIMARY ROUTE(S) OF EXPOSURE: Eye, Skin, Inhalation

EYE CONTACT: Can cause moderate to severe irritation.
SKIN CONTACT: May cause irritation with prolonged contact.
Can be harmful if absorbed.
INGESTION: Can cause central nervous system depression, nausea, dizziness, vomiting or unconsciousness depending on the length of exposure and on the first aid action given.
Can cause liver, kidney damage.
May cause red blood cell hemolysis.
INHALATION: May cause irritation to the respiratory tract and lungs.

SYMPTOMS OF EXPOSURE:
ACUTE: Inhalation of high concentrations of 2-butoxyethanol can cause nausea, dizziness, vomiting, stupor or unconsciousness.

CHRONIC: Repeated or prolonged exposure to 2-butoxyethanol can result in injury to liver, kidney or red blood cells (hemolysis).

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Prolonged skin contact with oxyalkylated organic ester may cause dermatitis.

AGGRAVATION OF EXISTING CONDITIONS: Skin contact may aggravate an existing dermatitis.

SECTION 04 FIRST AID INFORMATION

EYES: Immediately flush with water for at least 15 minutes while holding eyelids open. Call a physician at once.

SKIN: Wash thoroughly with soap and rinse with water. Call a physician.

INGESTION: Induce vomiting. Give water. Call a physician.

INHALATION: Remove to fresh air. Treat symptoms. Call a physician.

NOTE TO PHYSICIAN: Based on the individual reactions of the patient, the physician's judgment should be used to control symptoms and clinical condition.

CAUTION: If unconscious, having trouble breathing or in convulsions, do not induce vomiting or give water.

SECTION 05 FIRE FIGHTING MEASURES

FLASH POINT: 163 Degrees F (TCC)

UEL 10.6% LEL 1.1%

EXTINGUISHING MEDIA: Based on the NFPA guide, use dry chemical, foam, carbon dioxide or other extinguishing agent suitable for Class B fires. Use water to cool containers exposed to fire. For large fires, use water spray or fog, thoroughly drenching the burning material.

UNUSUAL FIRE AND EXPLOSION HAZARD: Containers exposed in a fire should be cooled with water to prevent vapor pressure buildup leading to a rupture.

SECTION 06 ACCIDENTAL RELEASE MEASURES

IN CASE OF TRANSPORTATION ACCIDENTS, CALL THE FOLLOWING 24-HOUR TELEPHONE NUMBER (800) I-M-ALERT or (800) 462-5378.

SPILL CONTROL AND RECOVERY:

Small liquid spills: Contain with absorbent material, such as clay, soil or any commercially available absorbent. Shovel reclaimed liquid and absorbent into recovery or salvage drums for disposal. Refer to CERCLA in Section 15.

Large liquid spills: Dike to prevent further movement and reclaim into recovery or salvage drums or tank truck for disposal. Refer to CERCLA in Section 15.

For large indoor spills, evacuate employees and ventilate area. Those responsible for control and recovery should wear the protective equipment specified in Section 8 .

SECTION 07 HANDLING AND STORAGE

Storage : Keep container closed when not in use.

SECTION 08 EXPOSURE CONTROLS AND PERSONAL PROTECTION

RESPIRATORY PROTECTION: Use either a chemical cartridge respirator with a black cartridge or supplied air.

For large spills, entry into large tanks, vessels or enclosed small spaces with inadequate ventilation, a positive pressure, self-contained breathing apparatus is recommended.

VENTILATION: General ventilation is recommended. Additionally, local exhaust ventilation is recommended where vapors, mists or aerosols may be released.

PROTECTIVE EQUIPMENT: Wear impermeable gloves, apron and chemical splash goggles. Examples of impermeable gloves available on the market are neoprene, nitrile, PVC, natural rubber, viton and butyl (compatibility studies have not been performed). A full slicker suit is recommended if gross exposure is possible.

The availability of an eye wash fountain and safety shower is recommended.

If clothing is contaminated, remove clothing and thoroughly wash the affected area. Launder contaminated clothing before reuse.

HUMAN EXPOSURE CHARACTERIZATION: Based on Nalco's recommended product application and our recommended personal protective equipment, the potential human exposure is: MODERATE.

SECTION 09 PHYSICAL AND CHEMICAL PROPERTIES

COLOR:	Clear to slightly hazy amber	
FORM:	Liquid	
ODOR:	Mild	
DENSITY:	8.2-8.5 lbs/gal.	
SOLUBILITY IN WATER:	Soluble	
SPECIFIC GRAVITY:	0.98-1.02 @ 60 Degrees F	
VISCOSITY:	160 cst @ 32 Degrees F, 65 cst @ 60 Degrees F, 22 cst @ 100 Degrees F	
POUR POINT:	Less than -40 Degrees F	
BOILING POINT:	340 Degrees F	
FLASH POINT:	163 Degrees F (TCC)	
VAPOR PRESSURE:	Less than 5 mm Hg (Less than 0.1 psi) @ 100 Degrees F	ASTM D-445
EVAPORATION RATE		

(BuAc = 1): 0.1

NOTE: These physical properties are typical values for this product.

SECTION 10 STABLILITY AND REACTIVITY

INCOMPATIBILITY: Avoid contact with strong oxidizers (eg. chlorine, peroxides, chromates, nitric acid, perchlorates, concentrated oxygen, permanganates) which can generate heat, fires, explosions and the release of toxic fumes.

STORAGE: Prevent contact with zinc, magnesium, and galvanized metals.

THERMAL DECOMPOSITION PRODUCTS: In the event of combustion CO, CO2, may be formed. Do not breathe smoke or fumes. Wear suitable protective equipment.

SECTION 11 TOXICOLOGICAL INFORMATION

TOXICITY STUDIES: Toxicity studies have been conducted on this product along with toxicity studies of the ingredient(s) in Section 2. The results are shown below.

ACUTE ORAL TOXICITY (ALBINO RATS):
2-Butoxyethanol LD50 = 470 mg/kg

ACUTE DERMAL TOXICITY (ALBINO RABBITS):
2-Butoxyethanol LD50 = 222 mg/kg
Product LD50 = Greater than 1,000 mg/kg

ACUTE INHALATION TOXICITY (ALBINO RATS):
2-Butoxyethanol LC50 = 700 ppm (7-hour exposure)

SECTION 12 ECOLOGICAL INFORMATION

If released into the environment, see CERCLA in Section 15.

SECTION 13 DISPOSAL CONSIDERATIONS

DISPOSAL: If this product becomes a waste, it does not meet the criteria of a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR 261, since it does not have the characteristics of Subpart C, nor is it listed under Subpart D.

As a non-hazardous liquid waste, it should be solidified with stabilizing agents (such as sand, fly ash, or cement) so that no free liquid remains before disposal to an industrial waste landfill. A non-hazardous liquid waste can also be incinerated in accordance with local, state and federal regulations.

SECTION 14 TRANSPORTATION INFORMATION

PROPER SHIPPING NAME/HAZARD CLASS MAY VARY BY PACKAGING, PROPERTIES,

AND MODE OF TRANSPORTATION. THIS PRODUCT IS REGULATED IN THE U.S. ONLY WHEN SHIPPED IN CONTAINERS EXCEEDING 119 GALLONS OR 882 POUNDS CAPACITY OR WHEN THE PACKAGE EXCEEDS THE REPORTABLE QUANTITY. TYPICAL PROPER SHIPPING NAMES FOR THIS PRODUCT ARE:

ALL TRANSPORTATION MODES (UNLESS SPECIFIED BELOW)	:	COMBUSTIBLE LIQUID, N.O.S.
AIR TRANSPORTATION (IATA/ICAO)	:	PRODUCT IS NOT REGULATED DURING TRANSPORTATION
MARINE TRANSPORTATION (IMDG/IMO)	:	PRODUCT IS NOT REGULATED DURING TRANSPORTATION
UN/ID NO	:	NA 1993
HAZARD CLASS - PRIMARY	:	3 - COMBUSTIBLE LIQUID
PACKING GROUP	:	III
IMDG PAGE NO	:	N/A
IATA PACKING INSTRUCTION	:	CARGO: N/A
IATA CARGO AIRCRAFT LIMIT	:	NO LIMIT (MAX NET QUANTITY PER PACKAGE)
FLASH POINT	:	163 F 72.7 C
TECHNICAL NAME(S)	:	GLYCOL ETHER
RQ LBS (PER PACKAGE)	:	NONE
RQ COMPONENT(S)	:	NONE

SECTION 15 REGULATORY INFORMATION

The following regulations apply to this product.

FEDERAL REGULATIONS:

OSHA HAZARD COMMUNICATION RULE, 29 CFR 1910.1200:
Based on our hazard evaluation, the following ingredient in this product is hazardous and the reason is shown below.

2-Butoxyethanol - Irritant, systemic effects, combustible

2-Butoxyethanol = TWA 25 ppm, 121 mg/m3 (skin) ACGIH/TLV

2-Butoxyethanol = TWA 25 ppm, 120 mg/m3 (skin) OSHA/PEL

CERCLA/SUPERFUND, 40 CFR 117, 302:
Notification of spills of this product is not required.

SARA/SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986 (TITLE III) - SECTIONS 302, 311, 312 AND 313:

SECTION 302 - EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355):
This product does not contain ingredients listed in Appendix A and B as an Extremely Hazardous Substance.

SECTIONS 311 and 312 - MATERIAL SAFETY DATA SHEET REQUIREMENTS (40 CFR 370):
Our hazard evaluation has found this product to be hazardous. The product should be reported under the following EPA hazard categories:

XX Immediate (acute) health hazard
XX Delayed (chronic) health hazard
XX Fire hazard
-- Sudden release of pressure hazard
-- Reactive hazard

Under SARA 311 and 312, the EPA has established threshold quantities for the reporting of hazardous chemicals. The current thresholds are: 500 pounds or the threshold planning quantity (TPQ), whichever is lower, for extremely hazardous substances and 10,000 pounds for all other hazardous chemicals.

SECTION 313 - LIST OF TOXIC CHEMICALS (40 CFR 372):
This product contains the following ingredient(s), (with CAS # and % range) which appear(s) on the List of Toxic Chemicals.

Glycol ethers	20-40	No CAS #

TOXIC SUBSTANCES CONTROL ACT (TSCA):
The chemical ingredients in this product are on the 8(b) Inventory List (40 CFR 710).

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA), 40 CFR 261 SUBPART C & D:
Consult Section 13 for RCRA classification.

FEDERAL WATER POLLUTION CONTROL ACT, CLEAN WATER ACT, 40 CFR 401.15/ formerly Sec. 307, 40 CFR 116/formerly Sec. 311:
None of the ingredients are specifically listed.

CLEAN AIR ACT, Sec. 111 (40 CFR 60), Sec. 112 (40 CFR 61, 1990 Amendments), Sec. 611 (40 CFR 82, CLASS I and II Ozone depleting substances):
This product contains the following ingredients covered by the Clean Air Act:

2-Butoxyethanol - Section 111
Glycol ethers (2-Butoxyethanol) - Section 112

STATE REGULATIONS:

CALIFORNIA PROPOSITION 65:
This product does not contain any chemicals which require warning under California Proposition 65.

MICHIGAN CRITICAL MATERIALS:
This product does not contain ingredients listed on the Michigan Critical Materials Register.

STATE RIGHT TO KNOW LAWS:
The following ingredient(s) are disclosed for compliance with State Right To

Know Laws:

2-Butoxyethanol 111-76-2

INTERNATIONAL REGULATIONS:

This is a WHMIS controlled product under The House of Commons of Canada Bill C-70 (Class D2B and Class B3). The product contains the following substance(s), from the Ingredient Disclosure List or has been evaluated based on its toxicological properties, to contain the following hazardous ingredient(s):

Chemical Name	CAS #	% Concentration Range
2-Butoxyethanol	111-76-2	20-40

SECTION 16 OTHER INFORMATION

Internal number F102962

SECTION 17 RISK CHARACTERIZATION

Due to our commitment to Product Stewardship, we have evaluated the human and environmental hazards and exposures of this product. Based on our recommended use of this product, we have characterized the product's general risk. This information should provide assistance for your own risk management practices. We have evaluated our product's risk as follows:

* The human risk is: MODERATE.
* The environmental risk is: LOW.

Any use inconsistent with Nalco's recommendations may affect our risk characterization. Our sales representative will assist you to determine if your product application is consistent with our recommendations. Together we can implement an appropriate risk management process.

This product material safety data sheet provides health and safety information. The product is to be used in applications consistent with our product literature. Individuals handling this product should be informed of the recommended safety precautions and should have access to this information. For any other uses, exposures should be evaluated so that appropriate handling practices and training programs can be established to insure safe workplace operations. Please consult your local sales representative for any further information.

SECTION 18 REFERENCES

Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists, OH.

Hazardous Substances Data Bank, National Library of Medicine, Bethesda, Maryland (CD-ROM version), Micromedex, Inc., Englewood, CO.

IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man, Geneva: World Health Organization, International Agency for Research on Cancer.

Integrated Risk Information System, U.S. Environmental Protection Agency, Washington, D.C. (CD-ROM version), Micromedex, Inc., Englewood, CO.

Annual Report on Carcinogens, National Toxicology Program, U.S. Department of Health and Human Services, Public Health Service.

Title 29 Code of Federal Regulations, Part 1910, Subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration (OSHA).

Registry of Toxic Effects of Chemical Substances, National Institute for Occupational Safety and Health, Cincinnati, Ohio (CD-ROM version), Micromedex, Inc., Englewood, CO.

Shepard's Catalog of Teratogenic Agents (CD-ROM version), Micromedex, Inc., Englewood, CO.

Suspect Chemicals Sourcebook (a guide to industrial chemicals covered under major regulatory and advisory programs), Roytech Publications (a Division of Ariel Corporation), Bethesda, MD.

The Teratogen Information System, University of Washington, Seattle, Washington (CD-ROM version), Micromedex, Inc., Englewood, CO.

PREPARED BY: William S. Utley, PhD., DABT, Manager, Product Safety
DATE CHANGED: 11/06/1997 DATE PRINTED: 03/28/1999

NALCO/EXXON
ENERGY CHEMICALS, L.P.

MATERIAL SAFETY DATA SHEET

PRODUCT

EC9500A COREXIT 9500

Emergency Telephone Number
Medical (800) 462-5378 (24 hours) (800) I-M-ALERT

SECTION 01 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

TRADE NAME: EC9500A COREXIT 9500
DESCRIPTION: A blend of oxyalkylate polymers, organic sulfonic acid salt, substituted fatty ester, glycol ether, and aliphatic hydrocarbon

NFPA 704M/HMIS RATING 1/1 HEALTH 1/1 FLAMMABILITY 0/0 REACTIVITY 0 OTHER
0=Insignificant 1=Slight 2=Moderate 3=High 4=Extreme

SECTION 02 COMPOSITION AND INFORMATION ON INGREDIENTS

Our hazard evaluation has identified the following chemical ingredient(s) as hazardous under OSHA's Hazard Communication Rule, 29 CFR 1910.1200. Consult Section 15 for the nature of the hazard(s).

INGREDIENT(S)	CAS #	APPROX.%
Hydrotreated light distillate	64742-47-8	20-40

SECTION 03 HAZARD IDENTIFICATION

EMERGENCY OVERVIEW:
CAUTION! May cause irritation to skin and eyes. Avoid contact with skin, eyes, and clothing. Avoid prolonged or repeated breathing of vapor. Use with adequate ventilation. Do not take internally.

Empty containers may contain residual product. Do not reuse container unless properly reconditioned.

PRIMARY ROUTE(S) OF EXPOSURE: Eye, Skin, Inhalation

EYE CONTACT: Can cause mild, short-lasting irritation.
SKIN CONTACT: May cause irritation with prolonged contact.

SYMPTOMS OF EXPOSURE:
ACUTE: Inhalation of high concentrations of hydrotreated light distillate can cause nausea, dizziness, vomiting, stupor or unconsciousness.

CHRONIC: Prolonged skin contact with hydrotreated light distillate can cause dry skin and defatting resulting in irritation and dermatitis.

AGGRAVATION OF EXISTING CONDITIONS: A review of available data does not identify any worsening of existing conditions.

SECTION 04 FIRST AID INFORMATION

EYES: Flush with water for 15 minutes. Call a physician.
SKIN: Wash thoroughly with soap and rinse with water. Call a physician.
INGESTION: Do not induce vomiting. Give water. Call a physician.

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INHALATION: Remove to fresh air. Treat symptoms. Call a physician.

NOTE TO PHYSICIAN: Based on the individual reactions of the patient, the physician's judgment should be used to control symptoms and clinical condition.

CAUTION: If unconscious, having trouble breathing or in convulsions, do not induce vomiting or give water.

SECTION 05 FIRE FIGHTING MEASURES

FLASH POINT: 210 Degrees F (PMCC) ASTM D-93

EXTINGUISHING MEDIA: Based on the NFPA guide, use dry chemical, foam, carbon dioxide or other extinguishing agent suitable for Class B fires. Use water to cool containers exposed to fire. For large fires, use water spray or fog, thoroughly drenching the burning material.

UNUSUAL FIRE AND EXPLOSION HAZARD: May evolve SOx under fire conditions.

SECTION 06 ACCIDENTAL RELEASE MEASURES

IN CASE OF TRANSPORTATION ACCIDENTS, CALL THE FOLLOWING 24-HOUR TELEPHONE NUMBER (800) I-M-ALERT or (800) 462-5378.

SPILL CONTROL AND RECOVERY:

Small liquid spills: Contain with absorbent material, such as clay, soil or any commercially available absorbent. Shovel reclaimed liquid and absorbent into recovery or salvage drums for disposal. Refer to CERCLA in Section 15.

Large liquid spills: Dike to prevent further movement and reclaim into recovery or salvage drums or tank truck for disposal. Refer to CERCLA in Section 15.

For large indoor spills, evacuate employees and ventilate area. Those responsible for control and recovery should wear the protective equipment specified in Section 8.

SECTION 07 HANDLING AND STORAGE

Storage : Keep container closed when not in use.

SECTION 08 EXPOSURE CONTROLS AND PERSONAL PROTECTION

RESPIRATORY PROTECTION: Respiratory protection is not normally needed since the volatility and toxicity are low. If significant mists are generated, use either a chemical cartridge respirator with a dust/mist prefilter or supplied air.

For large spills, entry into large tanks, vessels or enclosed small spaces with inadequate ventilation, a positive pressure, self-contained breathing apparatus is recommended.

VENTILATION: General ventilation is recommended.

PROTECTIVE EQUIPMENT: Use impermeable gloves and chemical splash goggles when attaching feeding equipment, doing maintenance or handling product. Examples of impermeable gloves available on the market are neoprene, nitrile, PVC, natural rubber, viton and butyl (compatibility studies have not been performed).

The availability of an eye wash fountain and safety shower is recommended.

If clothing is contaminated, remove clothing and thoroughly wash the affected area. Launder contaminated clothing before reuse.

HUMAN EXPOSURE CHARACTERIZATION: Based on Nalco's recommended product application and our recommended personal protective equipment, the potential human exposure is: MODERATE.

SECTION 09 PHYSICAL AND CHEMICAL PROPERTIES

COLOR:	Clear to slightly hazy amber	
FORM:	Liquid	
ODOR:	Hydrocarbon	
SOLUBILITY IN WATER:	Completely	
SPECIFIC GRAVITY:	0.95 @ 60 Degrees F	ASTM D-1298
VISCOSITY:	177 cst @ 32 Degrees F, 70 cst @ 60 Degrees F, 27 cst @ 100 Degrees F	
POUR POINT:	Less than -71 Degrees F	ASTM D-97
BOILING POINT:	296 Degrees F @ 760 mm Hg	ASTM D-86
FLASH POINT:	210 Degrees F (PMCC)	ASTM D-93
VAPOR PRESSURE:	15.5 mm Hg (0.3 ps8) @ 100 Degrees F	ASTM D-323

NOTE: These physical properties are typical values for this product.

SECTION 10 STABLILITY AND REACTIVITY

INCOMPATIBILITY: Avoid water contamination which may cause gelling.

Avoid contact with strong oxidizers (eg. chlorine, peroxides, chromates, nitric acid, perchlorates, concentrated oxygen, permanganates) which can generate heat, fires, explosions and the release of toxic fumes.

THERMAL DECOMPOSITION PRODUCTS: In the event of combustion CO, CO2, SOx, may be formed. Do not breathe smoke or fumes. Wear suitable protective equipment.

SECTION 11 TOXICOLOGICAL INFORMATION

TOXICITY STUDIES: No toxicity studies have been conducted on this product.

SECTION 12 ECOLOGICAL INFORMATION

If released into the environment, see CERCLA in Section 15.

SECTION 13 DISPOSAL CONSIDERATIONS

DISPOSAL: If this product becomes a waste, it does not meet the criteria of a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR 261, since it does not have the characteristics of Subpart C, nor is it listed under Subpart D.

As a non-hazardous liquid waste, it should be solidified with stabilizing agents (such as sand, fly ash, or cement) so that no free liquid remains before disposal to an industrial waste landfill. A non-hazardous liquid waste can also be incinerated in accordance with local, state and federal regulations.

SECTION 14 TRANSPORTATION INFORMATION

PROPER SHIPPING NAME/HAZARD CLASS MAY VARY BY PACKAGING, PROPERTIES, AND MODE OF TRANSPORTATION. TYPICAL PROPER SHIPPING NAMES FOR THIS PRODUCT ARE:

ALL TRANSPORTATION MODES : PRODUCT IS NOT REGULATED DURING TRANSPORTATION

SECTION 15 REGULATORY INFORMATION

The following regulations apply to this product.

FEDERAL REGULATIONS:

OSHA HAZARD COMMUNICATION RULE, 29 CFR 1910.1200:
Based on our hazard evaluation, the following ingredient in this product is hazardous and the reason is shown below.

Hydrotreated light distillate - skin irritant

Hydrotreated light distillate = TWA 5 mg/m3 ACGIH/TLV

Hydrotreated light distillate = TWA 5 mg/m3,
STEL 10 mg/m3, OSHA/PEL

CERCLA/SUPERFUND, 40 CFR 117, 302:
Notification of spills of this product is not required.

SARA/SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986
(TITLE III) - SECTIONS 302, 311, 312 AND 313:

SECTION 302 - EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355):
This product does not contain ingredients listed in Appendix A and B as an

Extremely Hazardous Substance.

SECTIONS 311 and 312 - MATERIAL SAFETY DATA SHEET REQUIREMENTS (40 CFR 370):
Our hazard evaluation has found this product to be hazardous. The product should be reported under the following EPA hazard categories:

XX Immediate (acute) health hazard
-- Delayed (chronic) health hazard
-- Fire hazard
-- Sudden release of pressure hazard
-- Reactive hazard

Under SARA 311 and 312, the EPA has established treshold quantities for the reporting of hazardous chemicals. The current thresholds are: 500 pounds or the threshold planning quantity (TPQ), whichever is lower, for extremely hazardous substances and 10,000 pounds for all other hazardous chemicals.

SECTION 313 - LIST OF TOXIC CHEMICALS (40 CFR 372):
This product does not contain ingredients on the List of Toxic Chemicals.

TOXIC SUBSTANCES CONTROL ACT (TSCA):
The chemical ingredients in this product are on the 8(b) Inventory List (40 CFR 710).

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA), 40 CFR 261 SUBPART C & D:
Consult Section 13 for RCRA classification.

FEDERAL WATER POLLUTION CONTROL ACT, CLEAN WATER ACT, 40 CFR 401.15/ formerly Sec. 307, 40 CFR 116/formerly Sec. 311:
None of the ingredients are specifically listed.

CLEAN AIR ACT, Sec. 111 (40 CFR 60), Sec. 112 (40 CFR 61, 1990 Amendments),
Sec. 611 (40 CFR 82, CLASS I and II Ozone depleting substances):
This product does not contain ingredients covered by the Clean Air Act.

STATE REGULATIONS:

CALIFORNIA PROPOSITION 65:
This product does not contain any chemicals which require warning under California Proposition 65.

MICHIGAN CRITICAL MATERIALS:
This product does not contain ingredients listed on the Michigan Critical Materials Register.

STATE RIGHT TO KNOW LAWS:
This product does not contain ingredients listed by State Right To Know Laws.

INTERNATIONAL REGULATIONS:

This is a WHMIS controlled product under The House of Commons of Canada Bill

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C-70 (Class D2B). The product contains the following substance(s), from the Ingredient Disclosure List or has been evaluated based on its toxicological properties, to contain the following hazardous ingredient(s):

Chemical Name	CAS #	% Concentration Range
Hydrotreated light distillate	64742-47-8	20-40

SECTION 16 OTHER INFORMATION

Nalco internal number F103745

SECTION 17 RISK CHARACTERIZATION

Due to our commitment to Product Stewardship, we have evaluated the human and environmental hazards and exposures of this product. Based on our recommended use of this product, we have characterized the product's general risk. This information should provide assistance for your own risk management practices. We have evaluated our product's risk as follows:

* The human risk is: MODERATE.

* The environmental risk is: LOW.

Any use inconsistent with Nalco's recommendations may affect our risk characterization. Our sales representative will assist you to determine if your product application is consistent with our recommendations. Together we can implement an appropriate risk management process.

This product material safety data sheet provides health and safety information. The product is to be used in applications consistent with our product literature. Individuals handling this product should be informed of the recommended safety precautions and should have access to this information. For any other uses, exposures should be evaluated so that appropriate handling practices and training programs can be established to insure safe workplace operations. Please consult your local sales representative for any further information.

SECTION 18 REFERENCES

Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists, OH.

Hazardous Substances Data Bank, National Library of Medicine, Bethesda, Maryland (CD-ROM version), Micromedex, Inc., Englewood, CO.

IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man, Geneva: World Health Organization, International Agency for Research on Cancer.

Integrated Risk Information System, U.S. Environmental Protection Agency, Washington, D.C. (CD-ROM version), Micromedex, Inc., Englewood, CO.

Annual Report on Carcinogens, National Toxicology Program, U.S. Department of Health and Human Services, Public Health Service.

Title 29 Code of Federal Regulations, Part 1910, Subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration (OSHA).

Registry of Toxic Effects of Chemical Substances, National Institute for Occupational Safety and Health, Cincinnati, Ohio (CD-ROM version), Micromedex, Inc., Englewood, CO.

Shepard's Catalog of Teratogenic Agents (CD-ROM version), Micromedex, Inc., Englewood, CO.

Suspect Chemicals Sourcebook (a guide to industrial chemicals covered under major regulatory and advisory programs), Roytech Publications (a Division of Ariel Corporation), Bethesda, MD.

The Teratogen Information System, University of Washington, Seattle, Washington (CD-ROM version), Micromedex, Inc., Englewood, CO.

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